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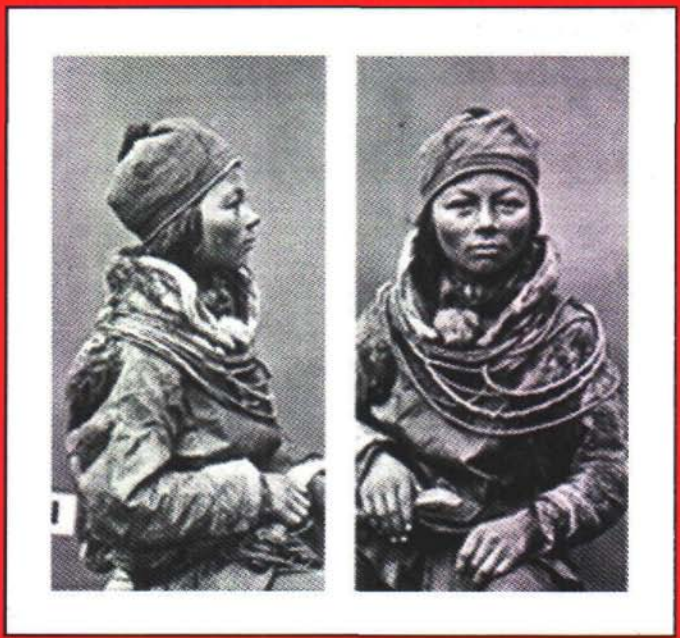

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Cover Picture: Young Uralic 'Saame' or Lapp. (See article: *Finnic-type Pronunciation in the Germanic Languages.*).

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Body Structure of Eighteen-Year-Old Conscripts Assessed by Anthropometry and Dual-Energy X-ray Absorptiometry

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We conducted an anthropometric study of 1123 conscripts aged 18 years from the town of Tartu and Tartu county . Height and weight, 33 anthropometric variables and 12 skinfolds were measured, body fat percentage was assessed by Omron®BF 300 hand-held segmental body fat analyzer. The data were systematized into five height-weight SD-classes, namely: 1 – small (small height and small weight), 2 – medium (medium height and medium weight), 3 – large (large height and large weight), 4 – weight class dominating and 5 – height class dominating. In classes 1, 2, and 3 the height and weight increase corresponded with increase in all heights, breadths and depths, circumferences, skinfolds, body fat, muscle and bone mass. In class 4 circumferences, skinfolds, body fat and muscle mass were bigger. In class 5 all heights as well as the absolute and the relative bone masses were bigger. The systematization of subjects into five classes is valid also for the body composition data assessed by double-energy x-ray absorptiometry. Some comparisons are made with studies of youths in neighboring countries

Key Words: Somatype; anthropometry; X-ray absorbtiometry; height; weight; skin thickness; body fat; body mass; Estonian conscripts.

Introduction

The human constitution has been and remains a subject of interest to investigators in physical anthropology, clinical medicine, epidemiology, health promotion and physical education and sports sciences.

Numerous different methods have been applied for the purpose of characterizing the human body as a whole. Hippocrates in the 5th century BC divided human bodies into two classes: *habitus phthisicus* (tall and thin) and *habitus apoplecticus* (short and thick). In the 19th and 20th centuries a number of scientists classified human bodies into three classes

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(reviews of Tucker, Lessa 1940; Conrad 1941; Albonico 1970). In Eastern Europe Kretschmer's (Kretschmer 1922) leptosome, athletic and pycnic are well-known terms. More recently the terms leptomorphic, metromorphic and pyknomorphic have come into use (Greil 1997).

In the English-speaking academic world, the somatotype technique introduced by Sheldon (Sheldon, Stevens, Tucker 1940) and modified by Cureton (Cureton 1947), Tanner (Tanner 1951), Parnell (Parnell 1954; Parnell 1958), Damon (Damon, Bleibtreu Elliot, Giles 1962), Petersen (Petersen 1967), Ostyn et al (Ostyn, Simons, Beunen, Renson, Van Gerven 1980) and Heath and Carter (Heath, Carter 1967; Carter, Heath 1990) is retaining popularity. In this system, three components of body build – endomorphy, mesomorphy and ectomorphy – are assessed on a point-score scale system in every subject. The Heath-Carter method uses anthropometric measurements for assessment of somatotype instead of photoscopic ratings and has opened up the scales. (Heath, Carter 1967; Carter, Heath 1990).

The Centre for Physical Anthropology at the University of Tartu has investigated the body structure of young women (Kaarma 1981, 1995) and concluded that body structure is a well-correlated system in which the leading variables are height and weight. Kaarma 1981, 1995; Saluvere Peterson, Saluste, Koskel 1998; Maiste, Kaarma, Thetloff 1999; Veldre, Stamm, Koskel 2002) recommended classifying body build, using 3x3 or 5x5 height and weight mean value and standard deviation (SD) classes, in a five-class system. This five-class model of systematization was applied in a study of 15-18-year-old girls (Peterson, Saluvere 1998; Saluvere, Peterson, Saluste, Koskel 1998; Maiste, Kaarma, Thetloff 1999). Using this model it is possible to systematize the other body measurements, body proportions and even characteristics of body composition. In a recent work it was shown that this model of classification is also appropriate for young pregnant women (Kaarma, Kasmel, Peterson, Veldre 2001).

The five classes of body build systematization of males was first applied in a study of Tartu Estonian school-leaving boys (Lintsi 1999; Lintsi, Kaarma, Saluste, Vasar 2002). By comparing multidimensional statistical models it was revealed that the classes defined this way proved different at a statistically significantly level from all other anthropometric variables,

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measured or calculated.

The aim of the present study was to investigate the five height and weight mean values and SD classes in the anthropometric data of young conscript men and to study the changes in their body structure.

The study was also aimed at investigating the changes in body composition variables of arms, legs, trunk and whole body, assessed by using dual-energy x-ray absorptiometry (DXA).

Material and Methods

In this study the anthropometric data of 1123 eighteen-year-old conscripts from the town of Tartu and Tartu county were analysed. All subjects were measured in a separated room and they were wearing only short cotton swimming trunks. The measurements were taken for each subject in all 47 anthropometric variables. The total body weight was measured with firm Soehnle digital scale with precision of 0.05 kg. While carrying out anthropometric measurements the rules of R. Martin (Martin 1928; Knussmann 1988) were followed. There were 8 height measurements: height, suprasternale, processus xiphoideus, umbilical, symphyseal, acromiale, dactylion and height of anterior superior iliac spine.

Breadth and depth measurements were as follows: biacromial breadth, chest and waist breadths depths, bicristal, elbow, wrist, femur and bimalleolar breadths. Abdomen depth was measured between umbilicus and processus spinosus columnae vertebralis lumbalis on horizontal plane. Circumferences (n=16) were measured as follows: neck, chest, maximum inspirational and maximum expirational chest circumference, waist, hip, arm relaxed, arm flexed and tensed, forearm, wrist, upper thigh, calf and minimum ankle circumference. Pelvis circumference was measured laterally at the level of the iliac crests (Wilmore, Behnke 1969). Midthigh was measured in the middle of distance between spina iliaca anterior superior and upper crest of patella. Head circumference was measured superior to the eyebrow line and encompassing the occipital protuberance. Skinfolds were as follows: chin, chest, midaxillary, suprailiac, supraspinale, subscapular, abdominal, biceps and triceps, femoral, calf and on dorsal surface of right hand. In skinfolds measuring also the recommendations of Lohman et al (Lohman, Roche, Martorell

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1988) and Heyward and Stolarzcyk (Heyward, Stolarczyk 1996) were followed. Skinfolds were measured twice and the values were averaged. All anthropometric variables were measured on the right side. Anthropometric measurements were performed by a trained anthropometrist, who had previously shown test-retest reliability of r>0.90. Measurements were performed in the morning between 9.00 and 12.00 AM.

Sternale length was calculated as suprasternale height minus processus xiphoideus height, abdominal length as processus xiphoideus height minus symphyseal height, trunk length as suprasternale height minus symphyseal height, upper limb length as acromiale height minus dactylion height and lower limb length as sum of the heights of anterior superior iliac spine and symphyseal divided by 2 (Jatsuta 1923).

Body mass index (BMI) was calculated as weight kg /(height m)^2. Body surface area was calculated according to the formula DuBois and Dubois (DuBois and DuBois 1916). We calculated also the local subcutaneous fat and the bone-muscle component on the cross-sectional areas of the arm and the thigh (De Koning, Binkhorst, Kauer, Thijssen 1986).

Skeleton muscle mass was assessed by regression equation (Lee, Wang, Heo, Ross, Janssen, Heymsfield 2000). SM= Ht x [0.00744 x CAG^2 + 0.00088 x CTG^2 + 0.00441 x CCG^2) + 2.4 x gender – 0.048 x age + 7.8, where Ht – height; CAG – corrected arm circumference; CTG – corrected midthigh circumference; CCG – corrected maximal calf circumference, gender (male =1, female = 0). Corrected circumferences was calculated as circumference – x skinfold thickness. Taken into account was the fact that measured skinfold thickness is a double skin and subcutaneous adipose tissue thickness.

Bone mass was calculated according to the following equation (Drinkwater, Martin, Ross, Clarys 1986): bone mass = [(HB + WB + FB + AB)/4]^2 x Ht x 0.92 x 0.001. Ht – height cm; HB – elbow breadth; WB – wrist breadth; FB – femur breadth; AB – bimalleolar breadth.

Omron ®BF 300 body fat monitor (Omron/Matsusaka Co Ltd., Japan) – the new hand-held BIA segmental unit, assessed body fat percentage. Information about the subject's height, weight, age and sex was entered into BIA data collection equipment. The resistance value was measured for each person as he comfortably gripped the handles of the BIA unit. Feet

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were placed shoulder width apart and the unit was held out in front of the body. The BIA unit has electrodes planted in the handles and the electrodes measure impedance to the current as it travels between the right and left hand. Approximately seven seconds after pressing the start button the fat percentage and fat mass are shown on the display. Measurements were taken twice and the values were averaged (Instructional manual 1998, Loy, Likes, Andrews, Vincent, Holland, Kawai, Cen, Swenberger, Van Loan, Tanaka, Heyward, Stolarczyk, Lohman, Going 1998; Gibson, Heyward, Mermier 2000).

Body structure classes were defined as recommended in literature (Kaarma 1981, 1995, Kaarma, Tapfer, Veldre, Thetloff, Saluste, Peterson 1996; Kaarma, Kasmel, Peterson, Veldre 2001; Peterson, Saluvere 1998; Saluvere, Peterson, Saluste, Koskel 1998; Maiste, Kaarma, Thetloff 1999). The mean height and SD (179.37 ± 6.53 cm) and the mean weight and SD (69.88 ± 9.93 kg) were calculated). The 3 x 3 system was used – small, medium and large. The medium class height was mean ± 0.5 SD (176.10 – 182.64 cm), the height values below this borders were defined as small and above as large. The medium weight was defined as mean ± 0.5 SD (64.92 -74.84 kg), the values below were assessed as small and the values above as a large.

By bivariate distribution of the height and weight of subjects a total of nine classes were created. All subjects were divided after that into five classes: 1 – small (small height and small weight), 2 – medium (medium height and medium weight), 3 – large (large height and large weight), 4 – weight class dominating over height class (contains 3 classes) and 5 – height class dominating over weight class (contains 3 classes).

Body composition was assessed also by dual-energy x-ray absorptiometry method (Mazess, Barden, Bisek, Hanson 1990; Kohrt 1998; Pietrobelli, Wang, Formica, Heymsfield 1998; Taylor, Jones, Williams, Goulding 2002) by total body scanning, using the Lunar DPX-IQ model (Lunar Radiation Corporation, Madison, Wisconsin, USA) and software 4.5 g in 41 conscripts. A single trained technician performed the measurements. The body composition was determined by measuring differential attenuation of bone, fat and lean tissue with minimal radiation exposure. The results were presented in g-s for bone mineral content (BMC), lean body mass (LBM) and fat mass, g/cm_ for

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mineral density (BMD), and as a percentage of body fat (BF%). The investigation was carried out at Tartu University Hospital in the Department of Internal Medicine, Division of Densitometry.

The same procedure of the body build systematization into five classes was also repeated with the body composition data obtained by DXA investigation.

The data were processed by SAS for Windows version 6.12 software. The difference between the mean values of variables and indices for three classes were evaluated by ANOVA-test, and the differences between two classes by Student t-test for independent samples. The level of significance was set at $p<0.05$.

Results

The mean height of 18-year-old conscripts was 179.81±6.59 cm and the mean weight 70.38±10.64 kg. The mean body mass index (BMI) was 21.74±2.84. The height correlation with lengths was r=0.268-0.844($p<0.05$), with breadths and depths r=0.159-0.499($p<0.05$), with circumferences r=0.134-0.371($p<0.05$) and with skinfolds r=0.018-0.077($p>0.05$). The weight correlation with lengths was r=0.181-0.370($p<0.05$), with breadths and depths r=0.364-0.741($p<0.05$), with circumferences r=0.514-0.844($p<0.05$) and with skinfolds r=0.580-0.729($p<0.05$).

The means and SD values of the data concerning the five classes are presented in Table 1. In the classes small – medium – large, where step by step weight and height are increasing, also lengths (variables 3-7), breadths and depths (v 8-17), circumferences (v 18-30) and skinfolds (v 31-41) increased. It is necessary to note that the proportions of the skeleton to the height remained stable (v 42-47, 49, 53, 55, 64) in all three classes. Skeleton proportions in the limbs also remained stable (v 67, 69, 73). On the other hand it is typical that relative circumferences in the classes small-medium-large increased (v 56-63, 65, 66, 70,71). All above-mentioned circumferences contained soft tissues. Total cross-sectional area of arm (v 77) and thigh (v 80) increased in classes small-medium-large, as well increases bone-muscle (v 78, 81) and fat areas too (v 79, 82). However the ratio of the bone-muscle rate to the total cross-sectional area of the arm (v 83) and thigh (v 85) decreased, but the fat rate of the cross-sectional area of the arm (v 84) and thigh (v 86) increased. The increase in height and weight in classes small-medium-large determines gradual changes in body

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composition. Step by step increase is characteristic of Rohrer index (v 87), BMI (v 88), body surface area (v 89), mean skinfold (v 90), mass of subcutaneous fat (v 92), body fat kg by OmronÆBF 300 (v 93), body fat % by Omron (v 94), muscle mass (v 95) and bone mass (v 97). In this occasion it is possible to say that in classes small-medium-large relative fat increases (v 91 and 94), but relative muscle and bone masses decreases (v 96, v 98).

The difference between classes four and five was of another kind. In class four the breadths and depths (v8 – v14), circumferences (v18-v30), skinfolds (v18-v41) and relative proportions (v47-v64, v65-v73, v75, v77, v79, v80, v82, v84, v86) also body composition indices as the Rohrer, BMI, fat tissue and muscle mass were bigger.

In class five height and all heights, ratio biacromial breadth/chest circumference, local bone-muscle rates of the arm and the thigh, relative muscle mass, and absolute and relative bone mass were bigger.

Table 2 shows the body composition data obtained by the double-energy x-ray absorptiometry (DXA).They are also divided into the five height-weights SD-classes. In the classes small-medium-large the lean body mass (LBM), bone mineral content (BMC) and fat mass ($p<0.05$-0.001) increased. Between classes four and five there is a significant difference in the fat content.

Discussion

Anthropometric studies of conscripts have been conducted in many countries and for many centuries. Such surveys of conscripts have provided useful material for investigating secular trend s(Hultkrantz 1927; Karpinos 1961; Udjus 1964; Gordon, Friedl 1994; Jaeger, Zellner, Kromeyer-Haushild, Lüdde, Eisele, Hebebrand 2001; Gyenis, Joubert 2002; Padez 2002), health and prognosis for future morbidity and mortality (Hoffmans, Kromhout, de Lezenne Coulander 1988; Tuvemo, Jonsson, Persson 1999), migratory processes (Kolodzeiej, Szklarska, Malina 2001) as well as for body build studies (Floris, Formenti, Sanna 1990).

For anthropometric assessment of conscripts usually height, weight, head and chest circumference and foot size are used. Restricting factors for anthropometric studies briefness may be a

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limited time and some other circumstances (Hauser, Danker, Gilbert 1981).

In the present investigation the 18-year-old conscripts were classified into the five height-weight SD-classes proposed in the publications of the Center for Physical Anthropology at the University of Tartu. Our investigation showed that in the classes – small (small height and small weight), medium (medium height and medium weight), and large (large height and large weight) – not only the height and weight were statistically significantly different, but nearly all anthropometric variables of the multidimensional stochastic model of the classes including the bone, muscle and body fat mass changed step by step.

The weight dominating (4) and the height dominating (5) classes also showed typical differences in the compared multidimensional model of the body structure including indices of body composition.

The body composition data investigation using the double-energy x-ray absorptiometry (DXA) confirmed that there is the change of the LBM, BMC and fat mass between classes small-medium-large on the one hand, and on the other hand there is a significant difference in the fat content between classes 4 and 5.

By our experience the height-weight SD-classes system is a simple basic model for systematization anthropometric data of conscripts of the same age and gender into classes where body size is taken into consideration. This system could be used for systematizing physiological, sociological, and nutritional characteristics also.

Some Comparisons with other Ethnic Groups

Statistics of the mean height, weight and body mass index (BMI) of conscripts is an important means for studying secular changes. The comparison between Strömberg's (cit. by Aul 1964) study of the mean height from the town of Dorpat (today Tartu) conscripts in 1886 and the present study shows that the mean height of conscripts has increased by 11.3 cm. The mean increment of height was 0.97 cm per decennium. Between the years 1978 and 1998-2002 the mean height of 18-year-old Tartu males has remained unchanged (179.8 cm). The mean height of Swedish conscripts was 179.0 cm in 1977 and 179.4 cm in 1996 (Lindgren 1998). Over the last 30 years the mean height of Norwegian conscripts has increased by only 1 cm, to 179.7 cm in

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2000 (Bjerkedal, Beckström, Brevik, Skaden 2001). In Finland the mean height of 18-year-old boys has increased over the last 22 years only by 0.9 cm, to 179.1 cm in 1999 (Kautianen, Rimpelä, Vikat, Virtanen 2002). The mean height of West-German conscripts has increased by 0.6 cm during the last 16 years, to 179.6 cm in 1998 (Jaeger, Zellner, Kromeyer-Haushild, Lüdde, Eisele, Hebebrand 2001).

Aul's (Aul 1982) study of 18-year-old schoolboys of the town Tartu and Tartu county in 1978 found that the mean weight of the town Tartu schoolboys was 67.28 kg and that of Tartu county schoolboys 69.80 kg. Over the last 20-24 years, the mean weight of the town Tartu and Tartu county conscripts has increased to 70.38 kg. The mean weight of Swedish conscripts in 1996 was 71.9 kg. In Finland, the mean weight of 18-year-old boys in 1999 was 72.1 kg. The mean weight of West-German conscripts in 1998 was 74.0 kg.

Using the international body mass index (BMI) criteria (Cole, Bellizzi, Flegal, Dietz 2000), the prevalence of overweight and obesity among Tartu and Tartu county conscripts was accordingly 8.77% and 1.44 %. The prevalence of overweight and obesity among Finnish and Swedish 18-year-old males is twice as high. As compared to Swedish (Rasmussen, Johansson, Hansen1999), Finnish and West-German subjects of the same 18-year-old age, the conscripts of the town Tartu and Tartu county have the lowest mean body weight and the lowest prevalence of overweight and obesity.

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14.	femur breadth	9.19	0.62	9.46	0.60	9.92	0.76	9.60	0.65	9.40	0.71	***	***	***	***	***
15.	ancle breadth	7.34	0.42	7.69	0.43	8.06	0.46	7.65	0.47	7.68	0.46	***	***	***	***	ns
16.	elbow breadth	7.02	0.37	7.26	0.36	7.55	0.42	7.27	0.45	7.23	0.38	***	***	***	***	ns
17.	wrist breadth	5.63	0.31	5.89	0.50	6.08	0.42	5.87	0.38	5.83	0.37	***	***	***	***	ns
	Circumferences (cm)															
18.	head circumference	56.14	1.47	57.40	1.25	58.48	1.34	57.46	1.45	56.84	1.49	***	***	***	***	***
19.	minimal neck circumference	34.91	1.36	36.42	1.34	38.31	1.74	37.57	1.56	35.54	1.44	***	***	***	***	***
20.	chest circumference	86.93	3.90	92.42	3.45	98.81	5.92	96.08	5.41	89.18	3.98	***	***	***	***	***
21.	waist circumference	70.72	3.48	75.14	2.96	81.86	6.66	79.73	5.90	72.26	3.62	***	***	***	***	***
22.	pelvis circumference	76.93	3.56	81.80	3.37	89.28	6.82	85.66	5.98	80.22	3.74	***	***	***	***	***
23.	hip circumference	86.20	3.53	91.29	3.25	98.32	6.40	94.18	5.45	89.38	3.67	***	***	***	***	***
24.	proximal thigh circumference	51.40	2.96	55.51	2.63	61.11	4.60	59.11	4.01	52.57	3.40	***	***	***	***	***
25.	midthigh circumference	45.43	2.94	48.74	3.18	53.04	4.54	51.17	4.32	46.27	3.30	***	***	***	***	***
26.	calf circumference	33.95	1.96	36.47	1.62	39.33	2.36	37.80	2.42	34.82	1.90	***	***	***	***	***
27.	ancle circumference	21.94	1.23	23.19	1.20	24.68	1.38	23.67	1.44	22.62	1.40	***	***	***	***	***
28.	arm circumference	26.67	1.92	28.48	1.42	31.15	2.81	30.77	2.35	26.63	1.73	***	***	***	***	***
29.	forearm circumference	24.98	1.35	26.37	1.10	28.15	1.76	27.52	1.54	25.34	1.39	***	***	***	***	***
30.	wrist circumference	16.56	0.68	17.27	0.65	18.15	0.87	17.65	0.77	17.07	0.74	***	***	***	***	***

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	Skinfolds (mm)															
31.	chin skinfold	3.96	1.00	4.44	1.27	5.32	2.25	5.32	1.88	4.09	0.98	***	***	***	***	***
32.	chest skinfold	4.79	1.53	5.33	1.70	6.95	3.58	7.07	3.46	4.65	1.25	***	***	***	***	***
33.	midaxillary skinfold	5.72	1.77	6.82	2.44	9.65	5.19	9.65	4.78	5.59	1.58	***	***	***	***	***
34.	suprailiac skinfold	7.50	2.86	9.07	3.25	12.63	6.06	12.99	6.55	7.49	2.72	***	***	***	***	***
35.	supraspinale skinfold	4.85	1.83	5.35	1.75	7.84	4.86	7.49	4.16	4.89	1.40	***	**	***	***	***
36.	abdominal skinfold	7.32	2.84	8.79	3.25	13.74	7.68	13.05	7.15	7.34	2.49	***	***	***	***	***
37.	subscapular skinfold	7.38	2.08	8.53	2.31	11.53	5.31	11.79	4.98	7.25	1.75	***	*	***	***	***
38.	biceps skinfold	4.12	1.59	4.45	1.69	5.84	2.83	5.96	2.74	4.07	2.39	***	***	***	***	***
39.	triceps skinfold	7.34	2.47	8.45	2.87	11.04	3.93	11.01	4.10	6.93	2.16	***	***	***	***	***
40.	thigh skinfold	11.29	3.46	13.10	4.04	16.27	5.35	15.95	5.84	11.01	3.32	***	***	***	***	***
41.	calf skinfold	7.97	2.69	8.81	2.76	11.39	4.04	11.01	3.61	7.64	2.35	***	**	***	***	***
	Proportions															
42.	relative trunk length (%)	29.73	1.23	29.42	1.29	29.56	1.31	29.60	1.34	29.51	1.43	ns	ns	ns	ns	ns
43.	relative abdominal length	19.77	1.33	19.73	1.49	19.61	1.51	19.69	1.63	19.64	1.53	ns	ns	ns	ns	ns
44.	relative upper limb length	44.22	1.27	44.39	1.26	44.27	1.43	44.34	1.25	44.25	1.31	ns	ns	ns	ns	ns
45.	relative lower limb length	53.00	1.30	53.24	1.27	53.37	1.46	52.98	1.50	53.44	1.40	ns	ns	ns	ns	ns
46.	relative biacromial breadth	22.36	0.86	22.47	0.77	22.25	0.85	23.01	0.84	21.74	0.82	ns	ns	ns	ns	***

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47.	relative chest breadth	15.27	0.96	15.28	0.82	15.46	1.03	15.99	0.99	14.62	0.82	ns	ns	ns	ns	***
48.	relative waist breadth	15.24	0.96	15.24	0.83	15.45	0.98	15.91	0.97	14.72	0.93	ns	ns	*	*	***
49.	relative bicristal breadth	15.30	1.06	15.37	0.93	15.50	1.04	15.65	1.06	15.22	0.95	ns	ns	ns	ns	***
50	relative chest depth	10.57	0.84	10.87	0.85	11.19	1.02	11.40	1.02	10.34	0.91	***	***	***	**	***
51.	relative abdomen depth	9.63	0.69	10.87	0.85	11.19	1.02	11.40	1.05	10.34	0.91	***	ns	***	***	***
52.	relative femur breadth	5.37	0.37	5.28	0.34	5.28	0.40	5.47	0.36	5.12	0.38	*	**	*	ns	***
53.	relative ancle breadth	4.29	0.25	4.29	0.24	4.30	0.23	4.36	0.25	4.19	0.24	ns	ns	*	ns	***
54.	relative elbow breadth	4.10	0.22	4.05	0.21	4.03	0.23	4.14	0.25	3.94	0.20	**	*	**	ns	***
55.	relative wrist breadth	3.29	0.18	3.28	0.28	3.24	0.22	3.35	0.21	3.18	0.20	ns	ns	*	ns	***
56.	relative chest circumference	50.79	2.36	51.52	1.99	52.67	3.29	54.77	2.84	48.60	2.05	***	***	***	***	***
57.	relative waist circumference	41.32	2.17	41.89	1.72	43.63	3.64	45.45	3.20	39.38	1.92	***	**	***	***	***
58.	relative pelvis circumference	44.95	2.17	45.60	1.95	47.58	3.68	48.83	3.23	43.72	1.80	***	**	***	***	***
59.	relative hip circumference	50.36	2.12	50.89	1.85	52.40	3.43	53.70	2.96	48.71	1.73	***	**	***	***	***
60.	relative proximal thigh circumference	30.03	1.77	30.95	1.56	32.58	2.53	33.70	2.17	28.65	1.72	***	***	***	***	***
61.	relative calf circumference	19.84	1.20	20.33	0.91	20.96	1.31	21.55	1.29	18.98	0.99	***	***	***	***	***
62.	relative arm circumference	15.58	1.18	15.87	0.82	16.60	1.53	17.54	1.29	14.52	0.95	***	**	***	***	***

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63.	relative forearm circumference	14.60	0.83	14.70	0.62	15.01	0.99	15.69	0.87	13.81	0.75	***	ns	***	***	***
64.	relative wrist circumference	9.67	0.41	9.63	0.37	9.67	0.47	10.06	0.43	9.30	0.40	ns	ns	ns	ns	***
	Limbs proportions															
65.	arm circumference/ upper limb length	35.27	2.93	35.80	2.23	37.55	3.72	39.61	3.28	32.84	2.44	***	*	***	***	***
66.	forearm circumference/ upper limb length	33.04	2.19	33.14	1.76	33.93	2.46	35.41	2.23	31.24	1.89	***	ns	***	***	***
67.	wrist circumference/ upper limb length	21.89	1.16	21.70	0.96	21.87	1.21	22.71	1.15	21.04	1.00	ns	ns	ns	ns	***
68.	elbow breadth/ upper limb length	9.28	0.58	9.12	0.49	9.10	0.60	9.36	0.62	8.92	0.50	**	**	**	ns	***
69.	wrist breadth/ upper limb length	7.44	0.48	7.40	0.63	7.32	0.57	7.55	0.52	7.19	0.48	ns	ns	ns	ns	***
70.	proximal thigh circumference/ lower limb length	56.71	3.91	58.17	3.39	61.08	5.09	63.66	4.52	53.65	3.69	***	***	***	***	***
71.	calf circumference/ lower limb length	37.45	2.56	38.20	1.93	39.30	2.61	40.70	2.62	35.55	2.12	***	**	***	***	***

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72.	femur breadth/ lower limb length	10.14	0.71	9.91	0.63	9.90	0.67	10.34	0.70	9.59	0.67	***	***	***	ns	***
73.	ancle breadth/ lower limb length	8.10	0.53	8.05	0.49	8.05	0.44	5.24	0.52	7.84	0.46	ns	ns	ns	ns	***
74.	chest depth/chest breadth	69.49	6.89	71.33	6.90	72.60	6.76	71.49	7.03	70.96	7.54	***	**	***	*	ns
75.	biacromial breadth/ bicristal breadth	146.98	13.22	146.67	10.31	144.14	11.59	147.63	11.46	143.38	10.20	ns	ns	*	*	***
76.	biacromial breadth/ chest circumference	44.09	2.10	43.66	1.93	42.26	2.50	42.09	2.24	44.78	2.01	***	*	***	***	***
77.	total cross-sectional area of arm (cm^2)	56.93	8.11	64.75	6.46	77.88	14.86	75.83	11.91	56.71	7.45	***	***	***	***	***
78.	bone-muscle rate of the cross-sectional area of arm (cm^2)	49.52	7.32	55.89	5.94	65.08	14.86	63.22	9.21	49.61	6.74	***	***	***	***	***
79.	fate rate of the cross-sectional area of arm (cm^2)	7.41	2.48	8.86	2.84	12.80	5.73	12.61	5.24	7.09	2.42	***	***	***	***	***
80.	total cross-sectional area of thigh (cm^2)	211.07	23.97	245.86	23.56	299.04	46.83	279.50	38.60	220.91	30.80	***	***	***	***	***
81.	bone-muscle rate of the cross-sectional area of thigh (cm^2)	182.90	19.89	210.77	19.85	251.23	37.40	233.99	27.62	192.81	27.29	***	***	***	***	***

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82.	fate rate of the cross-sectional area of thigh (cm^2)	28.18	9.21	35.09	11.28	47.81	18.58	45.51	18.64	28.10	9.02	***	***	***	***	***
83.	bone-muscle rate of the cross-sectional area of arm/ total cross-sectional area of arm	0.87	0.04	0.86	0.04	0.84	0.05	0.84	0.05	0.88	0.03	***	ns	***	***	***
84.	fate rate of the cross-sectional area of arm/ total cross-sectional area of arm	0.13	0.04	0.14	0.04	0.16	0.05	0.16	0.05	0.12	0.04	***	ns	***	***	***
85.	bone-muscle rate of the cross-sectional area of thigh/ total cross-sectional area of thigh	0.87	0.04	0.86	0.04	0.84	0.04	0.84	0.05	0.87	0.03	***	*	***	***	***
86.	fate rate of the cross-sectional area of thigh/ total cross-sectional area of thigh	0.13	0.04	0.14	0.04	0.16	0.04	0.16	0.05	0.13	0.03	***	*	***	***	***
	Indices and body composition															
87.	Rohrer index	1.18	0.09	1.21	0.06	1.28	0.15	1.39	0.12	1.06	0.07	***	***	***	***	***
88.	body mass index(BMI)	20.40	1.87	21.64	1.16	23.36	2.49	24.39	2.77	19.50	1.65	***	***	***	***	***
89.	body surface area (m^2)	1.69	0.07	1.88	0.03	2.10	0.10	1.91	0.11	1.86	0.09	***	***	***	***	***

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90.	mean skinfold	6.57	1.71	7.56	1.92	10.18	3.90	10.12	3.79	6.45	1.45	***	***	***	***	***
91.	mass of subcutaneous fat (kg)	10.02	2.73	12.77	3.33	19.51	8.55	17.55	7.54	10.81	2.64	***	***	***	***	***
92.	relative mass of subcutaneous fat (%)	16.90	4.08	18.32	4.53	22.55	7.18	22.92	7.45	16.47	3.41	***	**	***	***	***
93.	body fat kg by OMRON	4.85	1.71	7.11	2.73	13.82	6.61	10.74	5.49	5.58	2.08	***	***	***	***	***
94.	body fat % by OMRON	8.01	2.67	10.11	3.48	15.73	4.93	13.76	5.12	8.36	2.77	***	***	***	***	***
95.	muscle mass by Lee et al (kg)	31.34	1.58	34.15	1.18	37.87	2.53	35.11	2.22	33.68	1.91	***	***	***	***	***
96.	relative muscle mass by Lee et al (%)	52.56	2.21	49.47	1.56	46.43	2.30	47.53	2.27	51.26	2.44	***	***	***	***	***
97.	bone mass by Drinkwater et al (kg)	8.40	0.73	9.49	0.83	10.81	1.11	9.34	0.97	9.62	1.01	***	***	***	***	***
98.	relative bone mass by Drinkwater et al (%)	14.28	1.29	13.65	1.27	12.89	1.44	12.52	1.27	14.75	1.38	***	***	***	***	***

ns – nonsignificant. * $p<0.05$. ** $p<0.01$. *** $p<0.001$

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Table 2

Body composition data assessed by dual-energy x-ray absorptiometry and divided into five height-weight SD-classes

No	*Variable*	*Small mean±SD n=8*	*Medium mean±SD n=7*	*Large mean±SD n=7*	*Weight class dominating mean±SD n=7*	*Height class dominating mean±SD n=12*	*p-value 1-2-3*	*p-value 1-2*	*p-value 1-3*	*p-value 2-3*	*p-value 4-5*
1.	weight	61.28±5.02	70.90±3.48	88.30±9.87	80.34±11.14	66.51±4.99	***	***	***	***	***
2.	height	173.09±2.39	179.50±1.37	187.41±2.50	177.44±2.70	182.70±3.24	***	***	***	***	***
3.	LBM total	52.31±4.49	58.57±1.48	67.57±4.97	59.60±2.92	56.77±4.13	***	**	***	***	ns
4.	LBM arms	5.58±0.83	6.48±0.70	7.38±0.99	6.20±0.54	5.62±0.54	**	*	**	ns	*
5.	LBM legs	18.55±1.78	20.89±1.01	24.61±1.68	21.31±1.74	20.44±1.52	***	**	***	***	ns
6.	LBM trunk	24.58±2.03	27.82±1.14	31.84±3.56	28.50±1.64	26.96±2.50	***	**	***	**	ns
7.	BMC total	2.92±0.28	3.15±0.20	3.82±0.30	3.54±0.27	2.88±0.84	***	ns	***	***	ns
8.	BMC arms	0.38±0.06	0.41±0.06	0.47±0.07	0.39±0.07	0.43±0.20	*	ns	**	ns	ns
9.	BMC legs	1.07±0.08	1.19±0.10	1.48±0.10	1.34±0.15	1.18±0.16	***	*	***	***	*
10.	BMC trunk	1.97±2.62	1.11±0.07	1.37±0.17	1.29±0.15	1.25±0.56	ns	ns	ns	**	ns
11.	fat total	6.08±2.34	7.90±3.33	15.94±5.33	15.99±7.96	6.76±2.65	***	ns	**	**	***
12.	fat arms	0.48±0.38	0.57±0.25	1.39±0.63	1.30±0.85	0.43±0.22	**	ns	**	**	**
13.	fat legs	2.49±0.93	3.21±1.49	6.03±1.74	6.08±3.01	2.84±1.14	***	ns	***	**	**
14.	fat trunk	2.66±0.99	3.61±1.41	7.68±2.94	7.71±3.84	2.96±1.22	***	ns	***	**	***
15.	fat % total	10.35±3.62	11.71±4.32	18.80±4.90	20.37±7.43	10.55±3.66	***	ns	***	**	***

ns – nonsignificant; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

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Addendum

Statistics of the mean height, weight and body mass index (BMI) of conscripts is an important means for studying secular changes. The comparison between Strömberg's (cit. by Aul 1964) study of the mean height from the town of Dorpat (today Tartu) conscripts in 1886 and the present study shows that the mean height of conscripts has increased by 11.3 cm. The mean increment of height was 0.97 cm per decennium. Between the years 1978 and 1998-2002 the mean height of 18-year-old Tartu males has remained unchanged (179.8 cm). The

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mean height of Swedish conscripts was 179.0 cm in 1977 and 179.4 cm in 1996 (Lindgren 1998). Over the last 30 years the mean height of Norwegian conscripts has increased by only 1 cm, to 179.7 cm in 2000 (Bjerkedal, Beckström, Brevik, Skaden 2001). In Finland the mean height of 18-year-old boys has increased over the last 22 years only by 0.9 cm, to 179.1 cm in 1999 (Kautianen, Rimpelä, Vikat, Virtanen 2002). The mean height of West-German conscripts has increased by 0.6 cm during the last 16 years, to 179.6 cm in 1998 (Jaeger, Zellner, Kromeyer-Haushild, Lüdde, Eisele, Hebebrand 2001).

Aul's (Aul 1982) study of 18-year-old schoolboys of the town Tartu and Tartu county in 1978 found that the mean weight of the town Tartu schoolboys was 67.28 kg and that of Tartu county schoolboys 69.80 kg. Over the last 20-24 years, the mean weight of the town Tartu and Tartu county conscripts has increased to 70.38 kg. The mean weight of Swedish conscripts in 1996 was 71.9 kg. In Finland, the mean weight of 18-year-old boys in 1999 was 72.1 kg. The mean weight of West-German conscripts in 1998 was 74.0 kg.

Using the international body mass index (BMI) criteria (Cole, Bellizzi, Flegal, Dietz 2000), the prevalence of overweight and obesity among Tartu and Tartu county conscripts was accordingly 8.77% and 1.44 %. The prevalence of overweight and obesity among Finnish and Swedish 18-year-old males is twice as high. As compared to Swedish (Rasmussen, Johansson, Hansen 1999), Finnish and West-German subjects of the same 18-year-old age, the conscripts of the town Tartu and Tartu county have the lowest mean body weight and the lowest prevalence of overweight and obesity.

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Intervening with Mother Nature: The Ethics of Human Cloning

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The author examines reactionary ethical objections to research in medical genetics with particular regard to human reproduction, and selects the debate over the ethics of human cloning as occupying a central position for further analysis.

Key Words: Medical genetics; human reproduction; germ-line intervention; genetic disease; intelligence; human cloning; eugenics.

Leon R. Kass, Chairman of the President's Council on Bioethics, has stated that "Cloning not only carries high risks of bodily harm for the cloned child, but it also threatens the dignity of human procreation, giving one generation unprecedented genetic control over the next. It is the first step toward a eugenic world in which children become objects of manipulation and products of will."[2]

As a scientific experiment in bio-cloning may not work. Kass may be right. The bodily harm may be too great to yield a viable and functioning human being. We do not know, but we will try, despite the objections of officialdom. What is just as important as this most recent meddling with Mother Nature is that, if successful, human clones will constitute a truly remarkable, if not a revolutionary break with our reproductive sexual heritage.

Before we cry out with revulsion, our churches, synagogues, mosques, echoing lamentations of the power brokers and the religious conservatives fear less the poisonous smog of the internal combustion engine or the deafening cacophony of the "boom box" need to see what is behind the Current panic. Is it a real concern for human welfare or is it the politics of reaction?

We humans have tampered with nature ever since we experimented with the fermenting of grapes, or plunged a stuck pig into a blazing fire. Edward Jenner in the late century intuited the solution to the scourge of smallpox. Inoculate a related weak strain, cowpox, to prevent a truly horrifying

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[2] Kass, Leon. "How One Clone Leads to Another," *The New York Times*, 1/24/03.

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plagues of small pox. Jenner's scientific insight empowered us, in the medical sciences as elsewhere in technology and engineering, to shape nature so that it might serve the good of the human species.

Certainly, "giving one generation genetic control over the next" is an ambiguous phrase. For, in inoculating children against disease we will the softening of the randomness of disease and death in terms of the demographic profile of the next generation. As such, we exercise a measure of control over the genetic nature of subsequent generations.

During the twentieth century, two world wars and countless genocidal events selectively affected the most talented and productive minorities in the world, eliminating by the millions their genetic profiles from the generations that would follow. The twentieth-century contribution to the future of the species was the destruction worldwide of approximately 200 millions of our most talented, intelligent, productive humans.[3]

By the actions of human will, politically nihilistic and barbarous, we have reshaped the genetic nature of future human generations throughout the planet.

The unprecedented nature of genetic transmission through cloning might be revolutionary both in technology and in character. The future impact of a successful cloning methodology is difficult to foretell, were there to be large-scale adoption of such asexual reproduction. It could be a widely accepted international methodology for the conscious improvement of the species, i.e., eugenics. Else, an elitist preoccupation of the few. What we do know is that disease, war, genocide, even the subsidization of life at the edge, the medically salvaged, genetic carriers of disabilities have long become clear interventions with nature that allow the present generation to shape the genetic nature of the future. Cloning Humans?

The debate within the scientific community focuses on the use of experimentally-created (cloned) and normally conceived embryos in their first few days of existence from which we might harvest colonies of stems cells, the root structures out of which so many other organs are formed. The pro-cloning argument is

[3] Rummel, R. J. 1994. Death by Government, New Brunswick, N.J.: Transaction.

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that these stem cells represent the key to the advancement of medicine. A wide variety of possible cures now becomes possible, from the creation of new organs without fear of their being internally rejected, to the rehabilitation of people with differing neurological disabilities. Indeed, the future is so open-ended concerning the possibilities for the use of these cells that a vast new area of rehabilitative medicine might thereby be born.

These techniques have already been shown to have produced cloned animals that are designed for certain uses. such as cows, for their specialized milk production. Most recently, a mule was cloned. Despite Western Europeans' aversion to the new and their attempts to boycott genetically-modified crops, these latter are being widely planted. The planting of such crops, which are immune to disease, insect resistant, is exponentially expanding in Asia, thus threatening to put an end to starvation.[4] The international revulsion in the U.S. is also great. President George Bush in 2002 banned government financing of embryo research. Clearly, ideology reigns.

The possibility of creating cloned humans identical with the parent cells has mobilized officialdom, philosophers/ethicists, and theologians, from around the world. They rightly fear that banning cloning in the United States and in much of the West will not be enough. Other, dissenting and developed nations might not see cloning as a priori negative. In China, Israel, Russia, Japan, nations with the medical and technological wherewithal to attempt to clone a human being, the issue is still open. Once the cat is out of the bag officially, for instance, successful human clones, we will be forced to follow suit, else take up the rear in medical research. But even if these potentially-dissident nations put a halt to such work in their government-sponsored labs, there are many free lancers ready to fill the breach.

Even in the U.S., where the House of Representatives, religious and so-called "ethicist" organizations have declared the attempt to clone a human as immoral – but not in the Senate – it could be accomplished. Should cloning be banned?

Most opposition to human cloning now focuses on the

[4] Barboza, D. 2003. "Development of Biotech Crops Is Booming in Asia," *The New York Times*, 2/21/03.

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research build up to the creation of stem cells by the joining of the sexual cells of normal humans either within the body as a result of sexual congress, or in vitro, as a result of external test tube insemination of the egg cell by donated sperm. Many of these "created" embryos are the remains of the multiple embryos produced by couples in their attempts to effect normal pregnancies and birth. They are usually frozen, to be brought back later for genetic analysis and implantation in the female for a normal pregnancy. Many of these embryos become "extras." One implantation becomes successful, and the numerous embryos produced are rejected for full-term births. These extras are then volunteered for medical or stem cell research.

The anti-cloning argument proceeds from the view that the process of creating a plenitude of embryos for stem cell research is the first stage of widespread human cloning. It would become a separate process from the actual sexual union of egg and sperm for purpose of producing a normal birth. The view is that such work approaches the borders of inhuman experimentation, a tampering with one of the most fundamental biosocial acts, our fundamental sexual identity, and the creation of the next generation. The opponents, political, theological, ethical, view the normal sexual relations involved in creating a child as the closest to a divine act as we can get (Onan, son of Judah, Genesis 38:9.). Such a violation of our individual and our species' "godly" nature cannot be permitted. What is next on the horizon, they ask, *eugenics*?

The Moral/Religious Dimension

The Catholic Church has long wrestled with the issue of artificial birth control, coming down on the side of abstinence when the moral needs of the family, the health of the mother, economic stability requires that no new children enter the family circle. The Church strenuously objects to abortion as a birth control means. Cloning is seen as an extreme and horrific immoral procedure. Other religions are more pluralistic in their response to the issue of cloning. Perhaps they and we are overwhelmed by existing techniques of birth control, in vitro fertilization, all the varied methods of shopping for the "right" combination of female eggs and male sperm to accomplish the acts of conception through birth.

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In a world empty of humans, when wars inevitably led to the destruction, even genocide, of small tribal and national units, the Biblical injunction to procreate with its extreme hostility toward homosexuality and celibacy, anything that threatened the demographic survival of the ethnic group, had a thread of reality in its concerns. As with all such religious injunctions, the carriers of the message from God were always humans, laws of God usually promulgated on the basis of important contextual human needs.

Certainly, lessening the "dignity of human procreation through cloning, giving one generation unprecedented genetic control over the next" (Leon Kass, see above), is a fear opined in the context of a number of existing determinations of the nature and fate of the next generation by the present. For example, cannot it be said that the next generation's well being is undermined when individuals have far more children than the social environment can absorb, thus reshaping the genetic structure of subsequent generations, by duress: possible oblivion: starvation, disease, sterility? David Heyd has asked us to fix in our minds the ubiquitous truth that parents choose to have children for their own, not the children's benefit. This is a fundamental power exercised by the current generation over the next. The real question, then, directs itself to the method of genetic control exercised by one generation over the next. This is what Kass must object to, not the ubiquitous fact of control.[5]

What shocks today is the newly-developed technique of implanting the nucleus of an adult cell or "somatic" cell into a human egg cell from which the nucleus has been removed, thus creating a one-celled embryo. This embryo is subsequently grown in a Petri dish for five more days, thence assigned for either the harvesting of embryonic stem cells for research, else implanted in a human female's uterus for development and birth. Both the harvesting of such embryos and the prior act of cloning to produce such an embryo are at the heart of the momentary moral and religious fear.

The U.S. President's Council on Bioethics: "...the production of cloned embryos for any purpose is a significant

[5] Heyd, D. 1992. Genethics: Moral Issues in the Creation of People, Berkeley, CA: University of California Press.

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leap in transforming procreation into a form of manufacture."[6] Presumably, "form of manufacture" means that the pre-selection of the genetic material to be united with the female egg is identical to the genetic makeup of the pre-selected parental somatic cell. One notes that the development of techniques to overcome fertility often result in multiple births, many identical in genetic makeup. These could likewise, without excessive verbal legerdemain, be considered *artificially* created, sic: manufactured genetic entities. Again, could not the commonality of in vitro fertilization of donated semen or eggs, even artificial insemination of female(s) by semen donors also be defined as the *manufacture* of humans?

The question then focuses on techniques that take place with normal within-the-body inseminations, else sexual and asexual external techniques in reproduction. Perhaps the moral dilemma centers on the supposed sanctity of sexual reproduction, inside or outside the body. Yet, one hears few moral objections to reproductive technologies that since the 1970s have produced almost a million children, worldwide. These involve the above-noted "test tube" in vitro fertilization, sperm injected into egg cells (intercytoplasmic sperm injection), human embryos grown on cows and monkeys, component DNA from the eggs of two females, thus a child with genetic material from three parents. All these new techniques in part, to ameliorate the sterility of potential parents has caused the major birth defect rate to grow from 4 percent in normal sexual reproduction to 9 percent through these infertility technologies. Yet the U.S. government here engages in little regulation.[7]

Except for the Catholic Church's opposition to any tampering with the reproductive powers of sexuality, except abstinence, in practice rejected by Catholics in all developed nations. Catholic Spain and Italy being the great exemplifications of the use of artificial birth control by members of the educated Western community, no clear religious or moral ground exists for saying "desist." The Old Testament, the source of the religious guidance and injunctions concerning human sexual behavior for the three major Western religions, advocates

[6] Kass, Leon. op. cit.

[7] Skloot, R. L. 2003. "The Other Baby Experiment," *The New York Times,* 2/22/03.

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unlimited procreation, prohibits *coitus interruptus*, abortion, masturbation, homosexual behavior, all actions that have been seriously modified in their status as moral and religious transgressions by most modern religions. At the same time the Old Testament did sanctify the genocide of women and children, as well as male members of antagonistic ethnicities. It also promoted slavery, and polygyny.

Slippery-Slope Medicine

Here we confront the issue of correct interpersonal and social behavior. From a broader moral concern than strictly theological sanction, there are many who strongly reject the practice of creating an embryo and, after six days, or later, willfully ending its nascent life. The moral concern over such an act transcends particularistic religious sanction, for which there is little historical clarification. It is rooted in a definition of life. The issue has first addressed itself to abortion, where the Supreme Court (Roe v. Wade, 1972) required the states to permit abortion for the first trimester, to regulate it during the second trimester. The controversy now focuses on so-called partial-birth abortion (Stenberg v. Carhart, 2000). Here the Supreme Court ruled that Nebraska's banning of partial birth abortions was too broad. A ban here, during the third trimester, with an allowance for reasons of health, would have sufficed. On September 28, 2000, the U.S. Food and Drug Administration approved the use of RU-486, a pill that induces abortions during the first trimester.

Presumably the question of governmental legislative and legal intrusion in certain morally sensitive areas of public policy with regard to the "livingness" of embryos and fetuses during the first two trimesters of life is settled. In early 2003, the U.S. Senate was still entangled in defining whether a fetus, even in the second trimester, was a child that would "fully experience the pain" of an abortion.[8]

Constitutionally and ethically, up to the third trimester, choice over "life or death" resides in the privacy of the bearer of the fetus, her family and medical advisors. As we have pointed out above, most infertility technologies exercise this choice in creating a functioning embryo that is to be or not to be brought to term.

[8] *The Washington Post*, Editorial, 3/10/03.

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Thus, it is fair to say that the destruction of an embryo or fetus during pregnancy is an action within the law, and thus of established moral validation. It is inconceivable, a *reductio ad absurdum*, to postulate a federal law that permits certain behavior and then prevents the "moral" sanctioning of such behavior. Similarly validated is the creation of embryos by fertile couples to be genetically screened. The decision to bring to term or not, for those with reproductive or other problems, is likewise sanctioned within the law. These embryos could be frozen for subsequent genetic analysis and implantation. Surplus embryos could be contributed to scientific research and eventually destroyed.

The artificial creation of an asexual embryo, either for reproductive or stem cell research, has become the core of the most recent controversy over morality in this dramatic scientific and technological surge in bio-genetics. Stanford University's institute for stem cell research recently drew the ire of the President's Council on Bioethics because of its attempt to create embryos through somatic cell nuclear transfer (SCNT), now the most efficient manner of producing these living organisms for stem cell research.[9]

Opponents of this growing technique for producing stem cells, research that could eventually teach us much about the origins of disease, tissue rejection. organ repair and replacement, fear the slippery slope. By contrast, they hope that the use of adult cells can eventually lead to the production of stem cells, and thus avoid this revolution in the creation of "new life."

The President's Council on Bioethics declared that: "...the production of cloned embryos for any purpose is a significant leap in transforming procreation into a form of manufacture... saying yes to cloned embryos, even for research, means saying yes, at least in principle, to an ever-expanding genetic mastery of one generation over the next. Once cloned embryos exist in laboratories, the eugenic revolution will have begun....Science already permits us to screen human embryos in vitro for thousands of human genes. These include...not just sex, height, or skin color, but even intelligence, temperament or sexual orientation."[10]

In the area of socially-regulated moral behavior, the people

[9] Parens, E. 2003. "Clear Thinking on Cloning," *The Washington Post*, 2/1/03.
[10] Kass, op cit.

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and its government have a legal right to prohibit or sanction such behavior. The fact that the in vitro or in utero analysis of embryos for possible genetic defects takes place legally, thence allowable abortion or technological fertility and birth, emphasizes that a non-cloning aspect of the eugenics revolution is well under way. Another ubiquitous example is ultrasound technology. As utilized in China alone, it reduces the number of females born to China's 1.3 billion population by 1.7 million per year. In India, and elsewhere throughout the world, millions of females have been aborted after screening by ultrasound machines.[11]

That the eugenics revolution is not a mere phrase is a fear that some may say has been exploited by the Cystic Fibrosis Foundation. Their *raison d'etre* may disappear with genetic screening. They oppose genetic testing, without which children, parents, and society bear the responsibility for the medical burden of this devastating genetic condition.[12]

This struggle for scientific knowledge amidst the power interests favoring the status quo, especially when focused on the discoveries involved in our genome, often involve deeply-rooted political and ideological self-interest. Given the accepted view that approximately 50 percent of male homosexuality admits of a genetic origin, would the future discovery of a genetic location for male homosexuality allow parents to make a choice to abort or not? And would there not be deep protests by the political community representing homosexuals to defeat such free analysis and consequent decision-making?

An example of the positive moral impact on an ethnic community subject to genetic/eugenic research and applications are European (Ashkenazi) Jews, the main carriers of the genes for Tay-Sachs disease, a merciless neurological disorder that kills the vast majority of afflicted children by age five. By genetic screening of adults at risk, or women in pregnancy, thus eligible for an abortion, the incidence of the disease since the late 1970s has diminished by 95 percent in the Jewish population. Now researchers are directing their work at a

[11] Rothblatt, M. 1997. UnZipped Genes: Taking Charge of Baby Making in the New Millennium, Philadelphia: Temple University Press.

[12] Marshall, E. L. 1996. The Human Genome Project: Cracking the Code within Us, New York: Franklin Watts; Kristof, N. 2003. "The New Eugenics" *The New York Times*, 7/04/03.

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constellation of other genetically-transmitted conditions that affect Ashkenazi Jews and others, such as Cystic Fibrosis, Canavan, and Goucher.[13]

The moral question is how far our knowledge of the genetic nature of humans, both disabilities and advantages (intelligence, health), should extend into practice. The line between knowing and doing is a fine one. It is easier simply to prohibit the search for new knowledge before it gets to the stage of policy application. Thus, the inevitable moral slippery slope to the acceptance of a wide new range of biological/genetic "knowing and doing" becomes the center of a great national debate.

The Politics of Cloning

Concerning the issue of the power of one generation over the genetic nature of succeeding generations as discussed above, Kass and the President's Council subscribe to a spurious concern. The truth about human progress, horrific and benign, is that the act of creation usually takes place first; then comes the reconsideration of the wisdom of its use and practice. The mere moral objection to innovation because of the radical nature involved in the progressive technological jump usually does not block its application. If only we had foreseen the polluting and congestive impact of the internal combustion engine, seemingly benign and enthusiastically endorsed when introduced, would we have so easily acquiesced?

It is reactionary and ideological to foreclose progress in science and society merely on the suspicion of negative outcomes. One cannot predict the future. If the outcomes of human cloning are negative, were they to result in incessant failure or pathological results, then legislative action to regulate and limit human cloning would be justified on rational/evidential grounds. Hysteria and moral obfuscation would not. At this point, it is clear that the beginning stages of this biotechnology will reveal much failure. The products of failed experiments will not be allowed to enter the world. However, suppose after several years of failure, positive results occur, a normal healthy child. We would be well advised to

[13] Kolata, G. 2003. "Using Genetic Tests Ashkenazi Jews Vanquish a Disease," *The New York Times*, 2/18/03; Goddard, L. 2003. "Genetic Testing Offered," *South Florida Sun-Sentinel*, 2/21/03.

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inquire of this functioning productive human, "...are you worthy of your creation?"

Picture the aging parents of a child killed in an accident. They wish to recreate the child through cloning. Would we refuse them? A young husband dies suddenly. His wife wants a memory of their love in the form of a child cloned from his tissue? Could we say "no"? A different kind of experiment might be the cloning of a truly great mind. Several female proxies could be used, at the least to study the results of different intra-uterine and extra-uterine environments in the nurturing of the genetic potentialities of genius in human achievement. There is more to the historical implications of asexual human reproduction (cloning), than the mere venality of wealthy individuals striving for genetic immortality.[14]

The preemptive strike that so-called ethicists and politicians wish to achieve against stem-cell research that creates six-day-old embryos, not to say human cloning, has a deeper opposition. This again derives from the so-called slippery-slope argument, "the eugenics revolution." Eugenics has always spoken to the enhancement of the human species, by the possibility of eliminating such genetic conditions as Down's Syndrome, Tay-Sachs, as well as a host of tragic human disabilities that are increasingly controllable through the aegis of our exploding knowledge of the structure of the human genome.

The presumptive morality ideologues are certainly not against such human interventions. Kass focuses on one eminent danger involved in human genetic screening, and presumably the choice humans might make in creating a child: "...intelligence, temperament, or sexual orientation". These are ideological code words that center especially on intelligence and sexual orientation. Consider, a world of political activism without the highly intelligent, creative homosexual community, eliminated for all intents and purposes by the previous generation of parental choosers over the genetic destiny of their own family life, and, implicitly, the world's. Imagine hearing-impaired activists fighting cochlear implants or genetic screening so that the community of deaf and hearing-impaired persons might remain a politically potent group, or simply to

[14] Silver, L. M. 1997. Remaking Eden: Cloning and Beyond in a Brave New World, New York: Avon.

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ensure that there will be hearing-impaired people in future generations.

Note that it is genetically-rooted intelligence that lies at the heart of the opposition to the advancement of our knowledge of the human genome and the application of this knowledge to new therapies and procedures. The battleground is littered with unconsidered and unapplied evidence that human behavior is overwhelmingly shaped by our genetic intelligence, both quantitatively and qualitatively. Several important studies are pertinent here: L. M. Terman and M. H. Oden's longitudinal studies of high I.Q. children (1920-1945) revealed the educational and vocational success of the tested individuals. These studies, along with the Minnesota Twin Study, the results of which Thomas Bouchard started to present in 1988, clearly showed how closely linked intelligence and I.Q. are to the civilizational accomplishments of individuals, their social groups, even their nationalities and races.[15]

This research has proved anathema to various neo-Marxian political groups that view such accomplishments as accidental familial, sociological, and historical events that are unrelated to our biogenetic nature. According to the so-called left/liberal view, our human social natures are created by our environment, i.e., the political controllers. Here lies the *raison d'etre* for the genocide of talented minorities during the twentieth century. It started with the early-twentieth-century destruction of the Christian Armenians in Turkey, included the Jews, continued under Stalin and Mao. It contained an underlying demonology that the successful populations achieved their positions through illegitimate political if not criminal practices, not through education and ability.

The theme is the same today in the West, where the failures of various ethnic, religious and national groups to compete with high-ability minorities and nations has become a political weapon aimed at human achievement. The ideological fear concerns ongoing scientific research into the deepening mystery

[15] Terman, L. M. 1925. Genetic Studies of Genius, Vol. 1, Mental and Physical Traits of a Thousand Gifted Children, Stanford, CA: Stanford University Press; Terman, L. M., & Oden, M. H. 1948. The Gifted Child Grows Up: Twenty-Five Year Follow Up, Stanford, CA: Stanford University Press; Bouchard, T. J. 1993. "The Genetic Architecture of Human Intelligence," in P. A. Vernon, Ed., Biological Approaches to the Study of Human Intelligence, Norwood, N.J.: Ablex.

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of the nature/nurture interaction. By not merely mapping the genome but by identifying intelligent humans on the basis of specific gene complexes, even before birth, eugenics could be seen as a triumphant addition to the search for the good of humankind. The already failed environmentalist view of the primarily social origins of intelligence variability would be seen by all but the most unreachable as incontrovertibly wrong.

As it is, science is closing in on the genetic formulation of intelligence. Years ago, intelligence was seen as a blending of many genetic elements. The reason for this view lay in the many psychosocial elements that researchers used in their definition of intelligent behavior. More recently, partially through the above analysis of Thomas Bouchard, but also of Robert Plomin (U.S.-Great Britain), and Volkmar Weiss (Germany), "general intelligence – I.Q." is interpreted as a product of only a few major genes out of our human total of 22,000.[16] This change in perspective has been developed through a mathematical analysis of intra-familial I.Q. variability. These acknowledged large differences between full siblings preclude a blending model, and argue for the "right" major gene(s) complexes falling into one familial slot rather than the other.

We are gradually penetrating this mystery. More and more correlations are being made between brain size and intelligence, neurological synaptic electrical variance, and, most recently, brain scan studies correlated with I.Q. tests. Dr. Jeremy Gray, of Washington University, St. Louis, the lead author of a recently-reported study, argued that brain activity as imaged in the scans showed that high-LQ. persons taking an I.Q. test showed enhanced neurological activity in the lateral pre-frontal cortex, an area important for good working memory, planning. and goal directed activity.[17] Commentators unanimously agreed that "standard intelligence tests do measure something important" (Dr. John Duncan, deputy director. Medical Research Councils Brain Sciences Unit, Cambridge England). Further, "the idea that performance on a task that's supposed to tap into general intelligence can predict real differences in activity in the brain lends support for the idea that there is a general intelligence"

[16] Plomin, R., et al. 1997. Behavioral Genetics, New York: Freeman; Weiss, V. 1992. "Major Genes of General Intelligence," Personality and Individual Differences 13:1115-1134.

[17] Gray, J. R. 2003. In *Nature Neurosciences*, March.

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(I.Q.) (Dr. Earl Miller, Professor of Neuroscience, Picower Center for Learning and Memory, Mass. Institute of Technology).[18]

The cloning of humans and the stem cell production issue are indeed the tip of the iceberg, the slippery slope, or any other metaphor that points to the growing impact of scientific research that could undercut the twentieth-century ideological opposition to viewing human behavior as biologically/genetically determined. Let us suppose that we will soon identify the specific genes in our chromosomes that are linked with certain quantitative levels of intelligence and others that have qualitative valences, positive as well as negative, that might be predictive of violence, drug addiction, sexual pathologies? Would not such discoveries spill over into the legislative as well as the personal choice realm?

Let us assume that the quantitative analysis of general intelligence linked to biochemical gene structure begins to be predictive of educational achievement, the ability to think about causes, real or paranormal. Suppose we could attribute failed social, educational, moral behavior not to the depredations of "society" but to an individual's genetic makeup. From such a position, we could move to the macro-sociological impact. What are the links of an individual's genetic makeup to societies that cannot raise themselves economically, govern themselves democratically, rule out hallucinatory religious obeisance, or generate a political program of scientific, evidential, decision-making. When this day arrives, we will realize a completely different intellectual ordering of our national and international dynamics. We may be forced, unless ideology interdicts, to come to a wholly different understanding of the causes of our contemporary and historical dilemmas, political, economic, and social.

This would be a Copernican turn in our understanding. But for many true believers of the contemporary mythos, these are fighting ideas. Cloning is the controversial trip wire that allows for this recent ideological mobilization.

[18] Goode, E. 2003. "Brain Scans Reflect Problem-Solving Skill," *The New York Times* 2/17/03.

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Finnic-Type Pronunciation in the Germanic Languages

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In this paper a distinguished Estonian Scholar suggests that the Neolithic population of hunter-gatherers who occupied northern Europe during the Mesolithic spoke a Proto-Uralic language. He suggests that this population was probably not displaced by incoming Proto-Germanic-speaking Neolithic farmers, but that it acquired both farming techniques and the Proto-Germanic language by a process of cultural and linguistic diffusion over generations. If that were the case these early hunter-gatherers would be ancestral to the contemporary Nordic, Proto-Germanic-speaking peoples of Scandinavia and Northern Germany. On linguistic grounds this revolutionary thesis has been widely rejected by mainstream linguists on the grounds that if a Proto-Uralic-speaking population had accepted a Proto-Germanic language some Proto-Uralic words would have been absorbed into Proto-Germanic, whereas Proto-Germanic contains no loanwords from Proto-Uralic. It is rendered further questionable by genetic evidence (as summarized by Cavelli-Sforza et al. in *The History and Geography of Human Genes*, p.273) which reveals a major disparity between the genotype of the Uralic-speaking peoples of today and that of the Norwegians, Swedes, Danes and North Germans who would have to be descended from these early Proto-Uralic speakers if Wiik's hypothesis were true. The genetics of the Scandinavians and North Germans contrast too sharply with those of the main body of contemporary Uralic speakers to support Wiik's hypothesis. Only the Finns present us with a conundrum. They are genetically 90% European and only 10% Uralic; and it is believed that the 10% Uralic component primarily reflects relatively recent Finnish-Saame hybridization. However, Wiik's hypothesis is based on what he sees to be phonetic evidence, and his paper is presented here because of the novelty of his approach and its relevance to the still unsolved problem of the ethnicity of the pre-Neolithic occupants of northern Europe. It remains for linguists with a competent understanding of the evolutionary history of both the Germanic and Uralic languages to evaluate the phonetic arguments on which he builds his hypothesis.

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Key Words: Northern Europe; hunters-gatherers; farmers; Proto-Uralic; Proto-Germanic; Indo-European; Finno-Uralic; cultural and linguistic diffusion; demic diffusion.

The Starting Point

During the sixth millenium BC, Europe was divided into two broad subsistence zones:[2] the populations of the northern half of Europe were food gatherers, or more correctly, hunter-fisher-gatherers; the population of much of the southern half of Europe was food producing. In addition, the zone of the food producers was divided into western and eastern halves, because the populations of the loess region of Central Europe practiced farming and animal husbandry, while the populations of the steppe region north of the Black Sea practiced animal husbandry. The boundary between the northern and southern subsistence zones cut across Europe from the modern Netherlands through Central Europe to the Black Sea and to the southern parts of the Urals. The Uralic (U) protolanguage of the hunters became the *lingua franca*, or common means of communication, of the hunting populations of the northern half of Europe, while the *lingua franca* of the farmers, the Indo-European protolanguage, became its equivalent in the southern half of Europe. There must have been several dialects of both the Uralic- and the Indo-European protolanguages.

The Boundary Shift

After 5500 BC, the boundary separating the two subsistence zones started to shift toward the north. This occurred in two ways: through cultural and linguistic diffusion without population movements; and through migrations of southern food producers to the northern zone bringing their subsistence practices and languages (demic diffusion). My assumption is that the shift of the subsistence and linguistic boundary took place more often through the former than the latter method.[3]

The Language Shift

It was significant from a linguistic point of view that the northern hunters changed not just their subsistence but also their Uralic language (later Finno-Ugric [FU]) language to the Indo-European language. A U/FU > IE language change

[2]Dolukhanov 1979, pp. 187-200, 1986, 1989 and Zvelebil 1979, 1995a and 1995 b.

[3]Zvelebil 1995b, p. 110.

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occurred in the southern parts of the northern half of Europe, or in regions of modern northern Germany, Denmark, southern Sweden, Poland, Lithuania, and western Ukraine. The main purpose of this article is to look for evidence that this kind of language change actually did occur. This article deals with the western parts of the region where the language change took place, or those regions of northern Germany, Denmark, and southern Sweden where the Germanic protolanguage developed. Discussion of the Slavic and Baltic protolanguages and IE protolanguages located further east of these are left outside this article.

The Type of Language Shift

In a language shift where a population with a lower social status (U/FU-speaking hunter-fisher-gatherers of the above mentioned regions) changes their language to that of a population with a higher social status (IE-speaking farmer-herders of the regions in question), phonetic and syntactic elements of the language of the lower status group often survive as a substrate in the new language the lower status group learns.[4] Morphological or lexical elements of the language of the lower status group do not commonly survive as substrates, except to a very small extent. The failure to find loan words may be the reason why the U/FU substrate in Proto-Germanic has not been previously considered likely. Linguists have relied heavily on loan words in their research. Because Proto-Germanic does not have any U/FU loan words, or only a few of them, there cannot be any U/FU substrate according to these linguists. Since my own area of research is phonetics, I must present the kind of U/FU substrates I find in Proto-Germanic as a phonetician. I hope that an expert in syntax would similarly start to study the U/FU syntactic substrates of Proto-Germanic. I consider the existence of these syntactic substrates as probable. Unfortunately, studies of loan words and morphology do not contribute much when studying this type of language shift. (Actually, these studies may even have a negative influence if the researchers in question continue to maintain that linguistic contacts should result in many loan words).

[4]Thomason – Kaufman 1988, pp. 37-57.

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Sound Changes of Proto-Germanic

My starting point is that Proto-Germanic separated from the IE language unity as a result of certain sound changes, among other changes. I have made a list based on several descriptive works of the Germanic languages.[5] I do not claim that the list is complete. It includes some points which may surprise Germanists, for instance, foot isochrony and palatalization of consonants. It also includes several sound changes (such as umlauts and monophthongization of diphthongs) that are commonly considered more recent phenomena than the emergence of Proto-Germanic. As will be demonstrated below, I consider it possible for the "seeds" of many relatively recent phenomena to have already existed in Proto-Germanic. I will now explain further the factors that have led me to think in this way.

1. **Initial stress** or the fixing of stress on the first syllable of the word (*Akzentverschiebung/Akzentwandel*).
2. Change in the **quality of stress** from a relatively tonal type to a more **expiratory** type (more dynamic) and from a relatively even to a more centralized type.
3. **Foot isochrony.**
4. **Grimm's Law** (*die erste/germanische Lautverschiebung*).

4a. **Aspiration of plosives**

4b. **Tone of plosives**

5. **Verner's Law** (*das Vernersche Gesetz*).
6. Merger of the palatal and velar **places of articulation** in plosives.
7. **Palatalization** of consonants.

7a. **i-umlaut.**

7b. **Diphthong *ei* shortened to *i*.**

7c. Vowel change ***e* > *i*.**

7d. **Diphthongization of some monophthongs.**

7e. ***a*- and *u*-umlaut.**

8. **Dissolution of the syllabic resonants into an u** followed by the resonant in question.
9. **Merging of *ə* and *a* into an *a*.**
10. **Merging of *o* and *a* into an *a*.**

[5]Krahe 1960, pp. 43-96; Rooth 1962, pp. 103-206; Stolte 1962, pp. 9-18.; Haugen 1976; König 1978, pp. 43-83; Stedje 1989, pp. 44-46.

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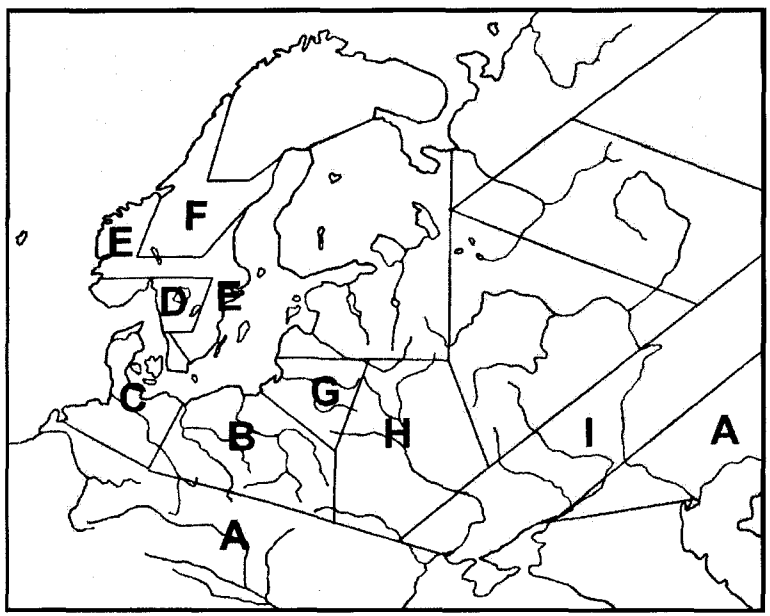
11. **Merging of *ó* and *á* into an *ó*.**
12. **Apocope of *a* and *e*.**

Next I shall present the most surprising claim of this article: *All of these sound changes are (or at least could be) U/FU substrate.* Put in a more concrete way, all of these may reflect the learning difficulties U/FU-speakers encountered when changing their language into an Indo-European one. This language shift occurred in northern Germany, Denmark, and southern Sweden within the time range of about 3500-2800/2300 BC. It goes without saying that the "language shift" here does not mean that each individual stopped speaking his or her old language and started to use a new language exclusively. This type of language shift is rare. The language shift here refers to a slow process that took place over many generations across large areas in which each new generation spoke the new language more fully and better than the preceding generation.



Cultures and Languages

That geographic area in which the U/SU > IE language shift most likely took place is northern Germany, Denmark, and

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Skåne. This is the region where the Proto-Germanic languages and people are traditionally considered to have emerged and from where Germanic languages have later spread in different directions.[6] This area is marked with a C on the map presented. There were several archeological cultures in this area between the end of the Ice Age and the beginning of the Bronze Age. The following are the most important of these cultures:[7] 1) the Hamburg, 2) the Ahrensburgian and Bromme, 3) the Maglemose, 4) the Kongemose, 5) the Ertebølle-Ellerbeck culture, 6) the Funnel-Beaker culture (TRB) and the Pit-Ceramic culture, as well as 7) the Single Grave culture and the Battle Axe (Corded Ware) culture. These cultures were followed by the Copper-Stone period and the Bronze Age.

The eleven cultures listed above are grouped into seven chronological periods because I consider in three cases that two cultures (the Ahrensburgian and the Bromme cultures, the Funnel-Beaker and Pit-Ceramic cultures, as well as the Single Grave and the Battle Axe cultures) represent approximately the same periods: The three latter periods are the most important in the matter of the U/FU > IE language shift. The cultures of these three periods are 1) the Ertebølle-Ellerbeck culture, 2) the Funnel-Beaker culture and the Pit-Ceramic culture, as well as 3) the Single Grave culture and the Battle Axe culture. The time range of these cultures was about 4200-2300 BC.

Basic Assumptions

My basic assumptions are the following:

1. The language of northern Europe's hunter-fisher-gatherer populations (such as the Ahrensburgian, the Bromme, the Maglemose, and the Kongemose) was *Proto-Uralic* (actually one or several dialects of this parent language),[8] whereas the language of more southern populations (such as the Linear Band Ceramic culture or LBK, the Tripolje-Cucuteni culture, and the Kurgan culture) was *Proto-Indo-European* (or one or several of its dialects). This is this article's basic postulation, the validity of which is at least at this stage impossible to prove conclusively although the most important claims in this article are based on it.

[6]For example, Keller 1978, p. 55 and Stedje 1998, p. 43.
[7]For example, Huurre 1995; Eesti Esiajalugu 1982 and Gimbutas 1991.
[8]Dolukhanov 1989, p. 84.

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2. The U/SU > IE language shift occurred when those populations speaking U/FU as their native language, and who lived in the north and closest to the IE-speaking populations *changed their language* to Indo-European. By "language shift," I refer here to a slow shift that took place over many generations, and which manifested itself when each younger generation spoke the new language somewhat better than the preceding older generation.
3. The language shift was a result of subsistence change when food collectors' (hunter-fisher-gatherers) subsistence strategies changed to that of food producers (farmer-herders) and when population sizes increased manifold (becoming even a hundred times larger).[9]
4. The subsistence system and language shift took place in two ways: through cultural-linguistic diffusion; through migrations and colonization. I assume the role of the cultural-linguistic diffusion to have been the greater of the two.[10] The model I use is, therefore, overwhelmingly "immobile": it does not presuppose large folk migrations, but it seeks to explain changes by postulating that populations mostly stay in place and that what essentially occurs is the spread of new subsistence practices, culture, and language to new regions. Therefore, I follow the view that has been gaining ground among archaeologists during the last few decades.[11]

Subsistence and linguistic zones:

A = The northernmost zone of the food producers and the IE language about 5500 BC. The area of LBK culture in Western and Eastern Europe.

B = The northernmost agricultural area of Western Europe about 4200 BC and the northernmost area of the IE language about 3500 BC. This is the "Oder-Vistula area" which is the area of the oldest IE language that has a U/FU substrate, possibly the area of Proto-North-Indo-European.

C = The area of the Ertebølle-Ellerbeck culture, or the northernmost agricultural area about 3500 BC and the area of the first stage of Proto-Germanic about 2800 BC.

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[9]Renfrew 1987, pp. 126-131.
[10]Zvelebil 1995b, p. 110.
[11]For example, Nuñez 1989 and Ligi 1993.

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D = The area of the TRB culture, or the northernmost agricultural area about 2800 BC and the area of the second stage of Proto-Germanic about 2300 BC.

E = The easternmost and northernmost agricultural areas of Scandinavia about 2300 BC and the area of the first stage of Proto-Scandinavian (North Germanic) or the area of the third stage of Proto-Germanic about 1800 BC.

F = The northernmost agricultural area of Scandinavia about 1800 BC and the northern area of Proto-Scandinavian about 800 BC.

G+H = The area of Proto-Balto-Slavic: Proto-Baltic in the Niemen region; Proto-Slavic in the Dnieper region.

I = The IE languages of the Kurgan culture with a substratum of the U/FU dialect of the lower Dnieper, Donets, and lower Volga areas.

The South-to-North Shift

According to the model I use, the U/FU > IE language shift started in northern Europe in the area where agriculture first arrived and moved from there toward the north. More specifically, the language shift started with the arrival of agriculture at the southern boundary of the area of the Proto-U/FU-speaking hunter-fisher-gatherers in eastern Germany and Poland during the sixth century BC.[12] The language shift and, therefore, the linguistic boundary between the U/FU and IE languages has moved northward until the present, so that today the language boundary is in northern Fennoscandia between Norwegian/Swedish/Russian and Lappish/Finnish/Karelian. The northward shift of the language shift and, therefore, the U/FU-IE language boundary has not yet stopped. This shift is still continuing, and Norwegian, Swedish, and Russian are gaining ground at the expense of Lappish, Finnish, and Karelian. When considering the linguistic influence (substrate) that has survived from the speakers of the Proto-U/FU in the Proto-Germanic spoken in northern Germany, Denmark, and southern Sweden, I focus on the most ancient stages of the language shift that occurred in the southernmost parts of the area. Before I discuss these stages, it is, however, necessary to

[12]For example, Piggot 1965, p. 59; Clark 1965; Renfrew 1987, pp. 152-159 and Huurre 1995, p. 25.

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provide a more general treatment of the topic.

Language Shift is Slow

When dealing with the movement of the language boundary in relation to that of a subsistence and cultural boundary, the simplest explanation is that these two boundaries shift at the same time and together all the time. If this were the case, the arrival of agriculture, for example, in northern Germany, Denmark, and Skåne would also mean a language shift, or the arrival of the IE language in this region. It is, however, known[13] that the language shift commonly occurs clearly later than the subsistence and culture shift. When a new subsistence and culture arrive in a region, it first shows as a change in those cultural traits directly involved with subsistence (for example, adaptation of agricultural tools) and as the arrival of a few linguistic elements (such as loan words).

Only much later, if the linguistic influence is strong enough and continues long enough, can a language change into another language. From a linguistic point-of-view, it is possible to distinguish two phases: a borrowing phase and a shifting phase. The essential question is: How long does it take for the shifting phase to be completed after the borrowing phase, or how long is the "linguistic time lag"? The answer, no doubt, is that the length of the time lag varies a great deal depending on the situation in question. For example, according to Korhonen, it can be 500-1000 years. I suggest the following "relative" solution:

Language shift takes place one cultural period later than the culture change.

Norbert Strade[14] has made a similar suggestion. According to this undeniably simplified model, the U/FU > IE language shift occurred in the area of the Ertebølle-Ellerbeck culture during the period of the TRB culture. The TRB culture is the culture that immediately succeeded the Ertebølle-Ellerbeck culture in northern Germany, Denmark, and southern Sweden. Therefore, the TRB culture represents the language shift-phase and the Ertebølle-Ellerbeck culture the borrowing phase preceding it. This principle may seem odd at first, but it is actually commonly used. For example, many Finnish

[13]Korhonen 1976, p. 11.
[14]Strade 1995.

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archeologists think that the Battle Axe culture and the Proto-Baltic language arrived in Finland in 2500-2300 BC, and that the Proto-Baltic language of the immigrants was assimilated into the language of the aboriginal population during the next cultural period (the Kiukais culture in 2000-1500 BC). In this case, there was a Baltic > FU language shift.

The following is a general scheme for three areas that are in different phases of development in respect to the subsistence and language: the southern area has already changed its subsistence and language, the central area is developing in the same direction, and the northern area has not yet been influenced by the new subsistence and language. Zvelebil[15] has presented a rather similar three-phase scheme for the subsistence change.

Hunting-fishing-gathering
U/FU language

Arrival of agriculture
Borrowing phase: the U/FU language with IE loanwords

Established agriculture
Shifting phase: the IE language with a U/FU substratum

Tables 1 and 2 presented below show in more detail this one period delay by which the linguistic change lags behind the subsistence change.

Seven Phases

I will next discuss in more detail those subsistence and language changes that took place in western parts of northern Europe. These changes are divided into seven phases.

Phase 0

This is the starting point. About 5500 BC the subsistence and language boundary went across central Germany; see area A on the map and the lowest line (agr-IE) of column 0 of table 1.

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[15]Zvelebil 1995b.

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Phase 1

Agriculture arrived in eastern Germany and Poland, more specifically in the "Oder-Vistula area" (area B on the map) with the spread of the central European LBK culture in 5500-4200 BC. The U/FU > IE language shift started at the southern boundary of the Oder-Vistula area at the beginning of this period while moving constantly northward, however, without reaching the northern boundary of this area by 4200 BC. Therefore, populations of the northern parts of the Oder-Vistula area at the end of this period were farmers, who still spoke U/FU language. Their language had most likely come under strong IE influence, and plenty of IE words were being borrowed into their language. The situation in the area B is described by the second lowest line of phase 1 in tables 1 and 2.

Phase 2

During the next cultural period (about 4200-3500 BC), agriculture spread to the northern Germany-Denmark-Skåne area (area C on the map and the third lowest line of phase 2 in tables 1 and 2), and the U/FU > IE language shift was completed in the entire Oder-Vistula area (compare the lowest and second lowest lines of phase 2 in table 1). Populations of the northern Germany-Denmark-Skåne area that now changed their subsistence from hunting to agriculture were the former Ertebølle-Ellerbeck populations (compare the specifications agr-U and Erteb on the third lowest lines of phase 2 in tables 1 and 2). As the specification U shows, the population had not yet changed its language, but IE linguistic elements (such as loan words) had been received already. The populations of the Oder-Vistula area, who changed their U/FU language to the IE represent the earliest populations that went through the U/FU > IE language shift. They were, thus, the first speakers of an IE dialect that has an U/FU substrate. This new northern IE language/dialect could be considered the North IE Proto-Language. This is the protolanguage from which the Germanic-, Slavic-, and Baltic- proto-languages emerged (under various U/FU and other influences).

Phase 3

Between 3500 and 2800 BC, the agricultural Funnel-Beaker Culture (the TRB, or *Trichterbecher*) spread to the north, reaching the approximate Oslo-Stockholm line in central

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Scandinavia (area D) excluding the coastal regions of Sweden (area E). IE linguistic elements must have arrived to the area with agriculture, but the language continued to be Finno-Ugrian. The coastal regions of Sweden belonged to the Scandinavian Pit-Ceramics culture also known as the "Settlement Site culture" of eastern Sweden. The fact that agriculture did not spread simultaneously in both inland and coastal regions is the result of a common tendency of the inland mobile hunters to adopt agriculture faster than the more sedentary fisher-sealer populations of the coastal regions.[16] The northward spread of agriculture stopped then for some time because the agricultural frontier had now reached the northern boundary of the deciduous forest, and the agricultural technology of the time was not yet suitable for regions of colder climate and different forest cover.[17] The reason that agriculture was not practiced in the coastal regions during this period is the abundance of food provided by fishing, sealing, and pig raising activities of the coastal populations which resulted in an unwillingness to change the subsistence.[18] Populations of the northern Germany-Denmark-Skåne area were now learning to speak an IE language and gradually shifted their language entirely into an Indo-European one. This language shift is the most important topic of this article because it designates the emergence of the earliest phase/stage of the Proto-Germanic, which is the daughter language of the IE protolanguage that has a strong U/FU substratum (more precisely, that of the Maglemose/Kongemose and the Ertebølle-Ellerbeck dialects).

To summarize, during this period: (a) populations of inland southern Sweden were already farmers but still spoke an FU language; (b) populations of coastal regions of southern Scandinavia were fishers, sealers, and pig herders, who also still spoke an FU language; (c) populations of northern Germany-Denmark-Skåne region were farmers, and they had already learnt to speak the "farmers" IE language (the Proto-Germanic).

Phase 4

The fourth period is that of the Single Grave and the (Scandinavian) Battle Axe (about 2800-2300 BC). During this

[16]Zvelebil 1979.
[17]Burenhult 1988, p. 69.
[18]Zvelebil 1979.

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period: (a) agriculture spread in some areas somewhat north of the Oslo-Stockholm line and also to the coastal areas of the former Pit Ceramics culture (entirely over the area E on the map), and (b) the farming population of the Swedish inland area (area D on the map) shifted its language from a Proto-Finnic to a Germanic one. During the Battle Axe period, agriculture reached its northern boundary and its spread slowed down or even came to a halt. This was analogous to the spread of the Battle Axe culture in Finland at the same time or a couple of centuries later. The language shift in question could be considered to signify the emergence of the next youngest, or the second, stage of the Proto-Germanic. (I do not even attempt to demonstrate in this article how the older and the younger stage of the Proto-Germanic differ from each other. I am satisfied to agree with the common opinion that the U/FU substratum is stronger in the older stage and weaker in the younger one.) In addition to those developments that took place in Scandinavia, similar developments took place as well in continental Europe. Also these regions (especially the region of the Single Grave culture) can be considered the areas of origin of "the second stage" of the Proto-Germanic.

That area of Scandinavia which was now having its first contacts with agriculture (area E on the map) can be considered analogous to the Battle Axe territories of Finland and other regions of the Baltic-Finnic Battle Axe culture. In Finland and neighboring areas, strong Baltic influence arriving with the agriculture gave emergence to a new dialect, Late Pre-Finnic or Baltic-Finnic. The new dialect can be symbolized as PF + b (read: Pre-Finnic with a Baltic abstrate). If we assume that analogous developments took place in Scandinavia at the same time, we can assume that in area E a Pre-Finnic dialect was spoken which had a strong Germanic (instead of Baltic) abstrate. This hypothetical "western dialect of the Baltic-Finnic" can be symbolized as PF + g (read: Pre-Finnic with a Germanic abstrate), and it probably included plenty of Germanic loan words instead of Baltic ones that existed in "eastern dialects of the Baltic-Finnic," or in the Late Pre-Finnic spoken in Finland and Estonia. Those Scandinavian populations living north of area E (and which are analogous to populations of inland and northern Finland) did not adopt agriculture. Nor did they receive strong Germanic linguistic influence. Their language

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was left more or less as it was. Therefore, they continued to speak early Pre-Finnic, which is now called Proto-Lappic. If this really is the case, the dialect boundary (the later language boundary) between Proto-Finnic and Proto-Lappic followed the traditional northern boundary of the Battle Axe culture from the Viipuri area in southeastern Finland to the Kokkola area in western Finland, from where it continued across the Bothnian Bay and Scandinavia to the Atlantic Ocean. (Compare with the northern boundary of area E on the map.) According to this scheme, there were three language- or dialect areas in Scandinavia: a Germanic language was spoken in southern Scandinavia; a late Pre-Finnic/Baltic-Finnic was spoken in central Scandinavia; Proto-Lappic (or its western dialect) was spoken in northern Scandinavia.

Phase 5

The fifth period is the Copper-Stone Age (Swedish *kopparstenålder*) of 2300-1800 BC,[19] during which the subsistence boundary gradually moved into southern parts of Norrland (see the northern boundary of area F on the map) where it stops for some time. The language boundary now reached the northern boundary of the Battle Axe culture (the northern boundary of area E), as well as the coastal regions of central and southern Sweden. From a linguistic point of view, this period may mean the emergence of the first phase of Proto-Scandinavian (North Germanic), or as the final stage of the Proto-Germanic.

Phase 6

During the period from 1800 to 800 BC, the subsistence boundary remained essentially unchanged, but the language boundary continued its shift until the subsistence and language boundaries coincided by 800 BC. The Lapps, subsiding on reindeer, lived north of this boundary and the Scandinavians, practicing farming, lived south of it.[20] The period of 1800-800 BC can be interpreted as the second stage of the Scandinavian protolanguage. (If phase 5 is interpreted as the last stage of the Proto-Germanic, phase 6 represents the initial stage of the Proto-Scandinavian). The Proto-Scandinavian linguistic period did not end in 800 BC, but it continued until the end of the

[19]Burenhult 1988.
[20]Burenhult 1988, p. 236.

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Viking period in AD 1050.[21]

Table 1

The subsistence systems and languages of eight different regions of Northern Europe during seven different periods.

Phase	0	1	2	3	4	5	6
BC	5500	4200	3500	2800	2300	1800	800
	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U
	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U	**agr-U**
F	hunt-U	hunt-U	hunt-U	hunt-U	hunt-U	**agr-U**	**agr-IE**
E	hunt-U	hunt-U	hunt-U	hunt-U seal-U	**agr-U**	**agr-IE**	agr-IE
D	hunt-U	hunt-U	hunt-U	**agr-U**	**agr-IE**	agr-IE	agr-IE
C	hunt-U	hunt-U	**agr-U**	**agr-IE**	agr-IE	agr-IE	agr-IE
B	hunt-U	**agr-IE**	**agr-U**	agr-IE	agr-IE	agr-IE	agr-IE
A	agr-IE	agr-IE	agr-IE	agr-IE	agr-IE	agr-IE	agr-IE

I have put together in Table 1 the subsistence systems and linguistic situations of western parts of northern Europe. The reading instructions for this table are the following:

The Y-axis represents the north-south directions of the map and the X-axis represents time. Boxes of the table refer to subsistence and linguistic situations in the following way:

(a) subsistence:

hunt = hunting-fishing-gathering

seal = sealing, fishing, and pig herding

agr = agriculture and animal husbandry

(b) language:

U = Uralic/Finno-Ugrian

IE = Indo-European

Areas and periods of change:

Simple underlying = the arrival of agriculture and loan words

Double underlying = the consolidation of agriculture and the language shift

[21]Haugen 1976.

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An example: a symbol agr-U of the line D in column 3 shows that the population living in area D (the inland of southern Sweden) were farmers during phase 3 (3500-2800 BC) and spoke a Uralic language which was already influenced by an IE language. This population's southern neighbors (agr-IE) were farmers who already spoke an IE language with a U/FU substrate. Their northern and eastern neighbors (hunt-U and seal-U) were hunters, sealers, and pig herders, who still spoke more or less "pure" U/FU language.

Table 2

The archeological cultures of the regions and phases presented in Table 1.

Phase	0	1	2	3	4	5	6
BC	5500	4200	3500	2800	2300	1800	800
	Komsa	Slate-Q	Slate-Q	Slate-Q	Asbest	Asbest	Asbest
	Fosna	Slate-Q	Slate-Q	Slate-Q	Asbest	Asbest	**Bronze**
F	Fosna	Slate-Q	Slate-Q	Slate-Q	Asbest	**Cop-St**	**Bronze**
E	Hensb	Slate-Q	Slate-Q	Slate-Q Pit-Pott	**BattA**	**Cop-St**	Bronze
D	**Hensb**	Slate-Q	Slate-Q	**TRB**	**BattA**	Cop-St	Bronze
C	Kongem	Erteb	**Erteb**	**TRB**	SingG	Cop-St	Bronze
B	Kongem	**LBK**	**TRB**	TRB	CordW	Cop-St	Bronze
A	LBK	LBK			CordW		Bronze

Hensb = Hensbacka
Kongem = Kongemose
LBK = Linear Band Ceramics
Slate-Q = Slate-Quartzite
Erteb = Ertebølle-Ellerbeck
TRB = Funnel Beaker
Pitt-Pott = Scandinavian Pit Pottery
Asbest = Asbestos Ceramics
BattA = Battle Axe
SingG = Single Grave
CordW = Corded Ware

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Cop-St = Copper-Stone Age

Bronze = Bronze Age

Table 2 has two types of "pioneering" cultures, which went through considerable changes. In some of these, there was a subsistence system change. In others, there was a language shift. The subsistence system changed in the following cultures:

1. The LBK culture in the Oder-Vistula area in 5500-4200 BC.
2. The Ertebølle-Ellerbeck culture in the northern Germany-Denmark-Skåne area in 4200-3500 BC.
3. The TRB culture (the Funnel-Beaker culture) in the inland area of southern Sweden in 3500-2800 BC.
4. The Battle-Axe culture in central Scandinavia and the coastal regions of inland Sweden in 2800-2300 BC.
5. During the Copper-Stone Age in central Scandinavia in 2300-1800 BC.
6. During the Bronze Age (the Scandinavian Bronze Culture) to the north of the last mentioned area in 1800-800 BC.

The language shift took place in five different regions during five different periods:

1. In the Oder-Vistula region in 4200-3500 BC.
2. In the northern Germany-Denmark-Skåne region in 3500-2800 BC.
3. In the inland of southern Sweden in 2800-2300 BC.
4. In the region north of the last mentioned region and in the coastal regions of southern Sweden in 2300-1800 BC.
5. In area F of the map in central Scandinavia 1800-800 BC.

It should be pointed out that, according to the principle used, the language shift occurs one cultural period later than the culture and subsistence change. This causes dates proposed by archeologists and linguists to approximate one another. It is known that dates proposed by linguists are commonly "far too recent" in comparison to archeological chronologies.

Proto-Baltic and Proto-Slavic

In addition to the Germanic and Scandinavian (North

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Germanic) protolanguages, other protolanguages also emerged in northern Europe at the same time (or a little later) in similar fashion: First the Balto-Slavic protolanguage was born in the region including parts of Poland, Lithuania, and Ukraine (areas G and H on the map).[22] Later, this protolanguage diverged into Proto-Baltic and Proto-Slavic, possibly so that the Proto-Baltic emerged in the Niemen River valley (G) and the Proto-Slavic in the Dnieper River valley (H). Also these protolanguages developed as a result of substrate influences of other (probably U/FU) languages.

The Language of the Kurgan Culture

An analogous language shift also took place in southeastern Europe. The Kurgan Culture of the steppe regions north of the Black Sea and the Caspian Sea (area I) spread to the lower Dnieper in the region of the Dnieper-Donets Culture.[23] The Finno-Ugric population of the region changed their language to an Indo-European one, and the result was an IE language including a FU linguistic substrate left from the Finno-Ugric population of the region.[24] The emergence of this language does not, however, belong within the scope of this article.

The Increasing Degree of Substratum

The above discussed development in the western parts of northern Europe led to an increasing degree of substratum, because the surviving substratum of a lost language is always stronger the further north and the later the language shift took place. In southernmost regions (the boundary of area A on the map) where the U and IE languages came into a contact, the IE language was still entirely "pure." In other words, it did not yet include any U substratum. It can be indicated with the symbol IE. When populations of the southernmost Uralic area changed their language into an Indo-European one, the Uralic language left a substrate in the new language. As a result, this language did not represent the most "pure" IE protolanguage. This language can be symbolized as IE + u. When an analogous language shift occurred later further north, a "pure" IE language did not mix with an U language, but an IE language

[22]Zvelebil 1995c, pp. 54-60 and Gimbutiene 1985, p. 74 and 128.
[23]Gimbutas 1991.
[24]Zvelebil 1995, pp. 54-60.

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including a weak U substrate (IE + u) and U language mixed. This mixing can be symbolized as (IE + u) + u. The mixed language that emerged had a somewhat stronger U substratum than the one that had emerged further south. We could say that the U substratum was gaining interest as the language shift progressed toward north. The result was that the further north the area where the language shift occurred the stronger the U/FU substratum. This increasing degree of substratum is seen in modern IE languages and dialects. The more northern the language or dialect, the stronger the U/FU substratum. Of course, this phenomena is also seen in the west-east orientation of boundaries between the IE languages and dialects.[25]

Three Reverse Situations

It is clear that agriculture did not arrive at any region suddenly and that it is impossible to define the exact date of agriculture's arrival. The arrival of agriculture was a long-term process including many stages. When I discuss "the arrival of agriculture" in the regions of northern Germany, Denmark, and southern Sweden, I refer to the first arrival of agriculture, which occurred sometime during the period 4200-3500 BC. There were later, decisive advances in agriculture that occurred during three periods: 1) 2800-1000 BC, 2) AD 200-400, 3) AD 800-1000.[26] There were two essential developments that had relevance to topics being discussed. First, the main boundary between the IE and FU languages continued its northward shift in Scandinavia. Second, IE-speaking groups (including traders and missionaries in addition to farmers) arrived in the coastal regions of Finland, Estonia, and Latvia. The IE immigrants were a clear numerical minority in these regions and, therefore, they were assimilated into the indigenous FU-speaking populations of the coastal regions as generations passed, leaving, however, their IE abstratum/substratum in the local FU languages. The result was an emergence of a new FU language/dialect. Important linguistic mixture events were: 1) the assimilation of the Proto-Baltic Battle Axe (Corded Ware) into the Early Proto-Finnic-speaking population and the emergence of the Late Proto-Finnic (the Baltic-Finnic); 2) assimilations of the Bronze Age Period Proto-Germanic-speaking groups and the Roman

[25]Pettersson – Platzack 1976.
[26]Jensen 1982, p. 76.

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Iron Age Period Proto-Scandinavian-speaking groups into the Proto-Finnic and the emergence of the Western Finnish dialects; 3) the assimilation of the Crusader Period Late Proto-Scandinavian- (or Proto-Swedish) speaking groups into the Western Finnish dialects and the emergence of the Southwest Finnish dialect. These cases deal with the IE > FU language shifts and the IE abstarum/superstratum in the FU languages and dialects. These three language shifts are not really within the scope of this article dealing with the U/FU > IE language shift. This shift took place with the earliest arrival of agriculture starting in northern Germany, Denmark, and southern Sweden during the period 4200-3500 BC or soon after, and whose memorial even today is the U/FU substratum in the Germanic languages.

The Phonetic Substrate

My goal is to demonstrate in the remaining part of this article that the U/FU > IE language shift really occurred. I use only phonetic (not lexical or syntactic) evidence because my own area of specialty is phonetics and in cases where a population with a lower social status changes its language to that of a higher status, the old language survives mainly as a phonetic substrate in the resulting language.

The Most Important Sound Changes of the Proto-Germanic

I now return to the Proto-Germanic sound changes listed at the beginning of this article and to the claim that all (or at least nearly all) of the sound changes of Proto-Germanic were pronunciation mistakes made by U/FU speakers who learned to speak IE protolanguage in northern Germany, Denmark, and southern Sweden in 4200-3500 BC or soon after.[27]

1. Position of Stress

The U/FU protolanguage had the initial stress always on the first syllable of the word,[28] but the stress of the IE protolanguage was "free," meaning that the stress could be on different syllables in different words or even different forms of the same word.[29] For example, *pɔ̄t'ēr* 'father' (stress on the second syllable) and *bhr'ātēr* (stress on the first syllable). The U/FU-

[27]Thomason – Kaufman 1988, pp. 37-45.
[28]Itkonen 1962.
[29]Haugen 1976, p. 103.

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speakers learning the new language had to learn the stress of each word and even different forms of the same word separately because they did not have for their use a common and simple rule for which a syllable was stressed in each case. The result was that they used rules of their own language and stressed the first syllable of each word. This pronunciation mistake takes place often today when the Finns learn IE languages in which the stress is (as a result of later developments) on some other syllable than the first. As a result, the Finns may stress the first syllable and say *d'iskutera 'intresanta pr'oblem* instead of using the correct Swedish pronunciation *diskut'era intres'anta probl'em.* Stress placing mistakes of the ancient U/FU-speakers learning an IE language have been later called the *Germanic stress shift* (*Akzentverschiebung / Akzentwandel*) by linguists.

The initial stress started to have similar repercussions in the Germanic languages than in the U/FU languages: *Alliteration* appears in both Finnic and Germanic folk poetries. Compare, for example, German *Her furlaet in lante luttila sitten, prut in bure barn unwahsan*[30] and Finnish *Mieleni minun tekevi, aivoni ajattelevi.* Both language groups make use of alliterate two-word pairs; for example, German *Mann und Maus,* English *part and parcel,* and Finnish *maita ja mantuja.*

2. Quality of Stress

The change in the quality of stress that took place in Proto-Germanic can be called a process of "*expiratization.*" This change means that the phonetic parameters of stress changed. The IE protolanguage's syllable had to have somewhat higher vibration so that speakers could notice it as stressed. Later (in the Proto-Germanic) the role of this vibration was reduced, and it was replaced by the force of air was exhaled (expiration). Now, the syllable had to be pronounced using relatively strong exhalation force to be recognized as a stressed syllable. How do we know this? One indicator of this is the probability that the IE protolanguage was a tonal language in which it was possible to change the word meaning at least in some cases by alternating the tone (vibration). The tonality of the IE protolanguage is indicated by numerous tonal languages within this language family today. The U/FU protolanguage was hardly a tonal

[30]Stedje 1989, p. 46.

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language. None of the recent U/FU languages are tonal.[31] The situation during the period of IE- and U/FU protolanguages may have been similar to the situation today between their daughter languages: the sound vibration is more melodious in the IE languages and more monotonic in the U/FU languages. Today, many speakers of IE languages pronounce stressed syllables in a way that sounds "singing" to the Finns. When the ancient speakers of the U/FU protolanguage were learning to speak the IE protolanguage, they may have pronounced stressed syllables with too little "singing" (alternating sound vibration too little) and by replacing the high sound vibration of stressed syllables with the increased force of exhalation (expiratization of stress).

The change of the phonetic parameters of stress was associated with *centralization of stress*. This change means that the stressed syllables became even more stressed and unstressed ones even more unstressed. How do we know that this really happened when speakers of the U/FU protolanguage were learning the stress patterns of the IE language? The claim may seem even ridiculous to the Finns, who know that the stress patterns in the IE languages spoken closest to us – the Germanic languages – are clearly more centralized than in Finnish language. One indicator that the situation was reversed during the time of the IE- and U/FU protolanguages is the vowel system of the unstressed syllables of these languages. The same vowels may exist in both unstressed and stressed syllables of the IE protolanguage in which the unstressed syllables may also have long vowels and diphthongs. In the U/FU protolanguage, the unstressed syllables had only two to four vowels, which were also always short. (In the U/FU protolanguage, the number of unstressed vowels was three according to Itkonen (1961), four according to Janhunen (1981) and Sammallahti (1988), but only two if the front- and back vowels of Janhunen's and Sammallahti's systems are interpreted as variants of the same phoneme. Some of these would appear only in front-vowels words and others in back-vowel words.) It can often be considered as centralization of stress if only certain short vowels can appear in unstressed syllables. Application of this

[31]We cannot consider even the break in Livonian as a tune phenomenom: Wiik 1995.

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observation to the IE and U/FU protolanguages provides a surprising discovery that the stress pattern of the U/FU protolanguage was more centralized than that of the IE protolanguage.[32] Therefore, the U/FU-speakers learning the IE language pronounced the stressed syllables "too much." This overemphasis of the stressed syllables was part of their U/FU accent. When we combine the quality of stress changes (the expiratization and the centralization) discussed above, we arrive at the conclusion that the U/FU-speakers habitually pronounced the stressed syllables of the IE language with too forceful exhalation and exaggeration of the difference between the stressed and unstressed syllables. These dialect characteristics had unpredictable consequences to the later development of the Germanic languages. These types of dialect characteristics have a tendency to become more extreme with time. When the Germanic language spread continually northward, the U/FU populations of the north came in contact with increasingly more "contaminated" dialects. When the southernmost U/FU-speakers heard still "pure" and "uncontaminated" IE protolanguage, their northern neighbors heard later somewhat "contaminated" IE language (dialect that had some U/FU characteristics). As the northward shift of the IE language continued and more northern U/FU populations changed their language to an increasingly "contaminated" IE language, the IE language (for example, Germanic) naturally changed with time, becoming increasingly "contaminated" (its U/FU substrate became stronger) as the language boundary shifted toward the north. *This increasing degree of U/FU substratum* naturally also effected the stress. The stressed syllables became increasingly expirated and centralized over time.

This process led to extremely substantial developments in the Germanic languages. I list the most important developments dealing with vowels:

a) The system of stressed vowels became more *diverse* as a result of the inclusion of a larger number of phonemes.

b) The system of unstressed vowels became *simpler,* so that eventually the system included only three phonemes: *i, u, a.*

[32]Sammallahti 1980.

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c) Unstressed vowels started to disappear as a result of *apocope* and *syncope.*

d) Long unstressed vowels and diphthongs became *simplified into short vowels.*

Although changes dealing with the vowels listed above reached their peak only during the period AD 500-1000, they may have had their roots already in Proto-Germanic. Development of these changes is a reflection of the increasing degree of U/FU substratum.

Changes and losses of unstressed vowels resulted in reduced role of unstressed vowels in differentiation of expressions. The unstressed vowels were often suffixes. Therefore, *the importance of suffixes reduced and separate little words* – for example, prepositions and adverbs – started to replace them. This meant the change of the entire language form: the Germanic languages evolved from a relatively synthetic language into a relatively analytic one.

Why did the expiratization and centralization of the stress cause weakening and losses of the unstressed vowels? Because these phenomena are typical of languages that have expirational stress for the following reasons: the amount of exhaled air available to produce each tempo/measure/unit (usually a segment of 1-3 syllables) is ultimately limited by the limited capacity of the lungs. When an increasing amount of this air allocated for each tempo is used to produce a stressed syllable (compare with the earlier discussed "expiratization"), there is a decreasing amount of air for the unstressed syllables, which will weaken and possibly disappear entirely. The weakening and loss of unstressed syllables is not equally common in languages where stress is based more on the height of the fundamental frequency and less on the exhalation. The fundamental frequency can be elevated by the muscular action of the vocal cords, not by elevated force of exhalation.

3. Foot Isochrony

In all Baltic-Finnic languages the vowel of the second syllable is longer after a short first syllable than after a long first syllable. For example, in Finnish (in all of its dialects) *a* is longer in the word *muta* than in the words *muuta, mutta,* or *musta.* The same phenomenon seems to appear also in Lapp and possibly also in

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Mordvin.[33] I assume that the foot isochrony is an old phenomenon, which has taken place at least in early Proto-Finnic and possibly in other FU languages as well. It is not certain if the foot isochrony was already occurring in the Proto-Germanic, but it was certainly taking place in the western and northern dialect of the Germanic when the apocope and syncope started to have influence on unstressed vowels. The vowel losses first affected only those unstressed vowels that were preceded by a long first syllable and only later those that were preceded by a short first syllable. Compare, for example, Proto-Germanic 'boy' and 'hand' words (Gothic *sunus* and *handus*), the ancient Upper German forms of which were *sunu and hant_*.[34] This two-stage process is explainable by the foot isochrony occurring in the language in question. At a later date and further north, the foot isochrony became stronger (the Germanic language became increasingly "contaminated" with the increase of FU substratum) and it received other forms of expressions also. For example, foot isochrony is expressed as *vowel balance* (Danish *likevekt* and Norwegian *jamvekt*) in central and northern Scandinavia. Compare the above with *livå – briste/ brist_*, which are based on earlier forms *liva* and *brista*, since the labialization of vowel *a* into *å* effected only long vowels (or those following short first syllable) and not short ones (or those following long first syllable).

4. Grimm's Law

This law, or the first/Germanic sound shift, refers traditionally to shifts in three plosives:

a) the unvoiced (aspirated/unaspirated) plosives became corresponding voiceless fricatives:

$$p/ph > f, \qquad t/th > \text{þ}, \ \text{þ} \quad k/kh > \chi;$$

b) the voiced aspirated plosives became corresponding voiced fricatives:

$$bh > \beta, \qquad dh > \delta, \qquad gh > \gamma;$$

c) the voiced unaspirated plosives became corresponding voiceless unaspirated plosives:

$$b > p, \qquad d > t, \ g > k.$$

[33]Korhonen 1981, pp. 345-5.
[34]König 1978, p. 53.

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In the case of *p/ph* > *f*, the result of the shift may have been at first the fricative *Φ*, which is homo-organic (bilabial) with *p/ph*, but later it became labiodental *f*, because the labiodental fricative is less marked than the bilabial one. Velar *χ* may have later changed into laryngeal *h* for the same reason.

A comparison of the plosive systems of the IE and U/FU protolanguages is needed to show that these Grimm's Law changes are really U/FU substrate:

IE protolanguage:	*ph*	*th*	*kh*
	p	*t*	*k*
	b	*d*	*g*
	bh	*dh*	*gh*

Probably aspirated and unaspirated plosives (for example, *ph* and *p*) were allophemes of the same phoneme.

U/FU protolanguage:	*p*	*t*	*k*

The U/FU protolanguage had a phoneme marked with the symbol *d*, but, for example, Sammallahti interprets this to be the phonetically spirant *δ*.[35]

The plosive systems of the IE and U/FU protolanguages were, therefore, quite different. There were at least nine (actually 12 as will be demonstrated below) plosive phonemes in the IE protolanguage, while the U/FU protolanguage had only three. Furthermore, the distinctive characteristics of the plosive phonemes were different in that the IE plosive system had two characteristics – aspiration and voice – which were missing from the U/FU plosive system. It is, therefore, probable that speakers of the U/FU protolanguage had difficulties in hearing and producing differences between aspirated and unaspirated plosives and voiced and voiceless plosives. I will first discuss learning difficulties dealing with aspiration and then those dealing with voice.

4a. Aspiration

Plosives of the IE protolanguage are traditionally interpreted a s friction noise in the vocal cords during a few centiseconds after the explosion of the plosive, when the gap located between the cartilage of the vocal cords is so narrow that the air particles

[35]Sammallahti 1988, pp. 482 and 491-2.

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rub against falls of this gap. This friction noise originating in the larynx is usually symbolized with *h*. In addition, it is also thought that similar (voiceless) aspiration takes place in both voiceless and voiced plosives that are aspirated, for example *ph* and *bh*. It is, however, probable that the "aspiration" of the plosives of the IE protolanguage were not of this laryngeal *h*-like type. It was a noise produced at the place of the articulation of the plosive when the closure of the plosive was closed so slowly that there was such a narrow gap at the place of articulation during a few centiseconds that the air particles rubbed against falls of the gap. This type of noise is known as a *fricative* rather than aspiration.[36] Nor does it sound like *h*, but as a fricative produced at the place of articulation of a plosive. For example, like *ϕ/f* and *β/v* in place of *p* and *b*, and *þ* and *ð* in place of *t* and *d*, as well as *h/x* and *γ* in place of *k* and *g*. A known modern language example is the Danish "aspirated" t in word *tivoli*, for example. In the Danish *t*, "aspiration" occurs in *t*'s place of articulation and sounds like a sibilant *s* (*tsivoli*) articulated at this place of articulation. Therefore, the Danish "aspiration" is actually "frication." It may have been a similar situation in the case of the IE protolanguage, but so that the frication appearing with t was not sibilant *s* but spirant *þ*. In addition, the frication must have been voiced in connection with voiced plosives, because pronouncing a voiceless spirant with a voiced plosive (that is, the loss of voice at the explosive moment of plosive) does not feel natural. Based on this, the aspirated plosives of the IE protolanguage had the following phonetic qualities (I do not pay attention here to the fact that there were actually four places of articulation):

pΦ	*tþ*	*kx*
bβ	*dδ*	*gγ*

For additional proof that the aspirated plosives of the IE protolanguage really had these phonetic qualities, one can present the identification of those having learned U/FU. These are:

f	*þ*	*χ*
v	*δ*	*γ*

These identifications allow the following generalizations: the

[36]Wiik 1981, p. 75.

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learners of the U/FU heard only the "aspirated part" of the "aspirated" plosives of the IE protolanguage. They did not hear their plosive part (or, more correctly, occlusion part). The situation was, therefore, similar to the situation today, when the Finns hear only f and p of the German words starting with pf-sounds (for example, the word Pfad). This insufficient recognition and incomplete pronunciation resulting when U/FU native speakers pronounce foreign words resulted in the "aspiration part" of the Proto-German's Grimm's Law. That is, the "aspirated" plosives became corresponding fricatives:

$$p\Phi > \Phi > f, \qquad t\underline{p} > \underline{p}, \qquad kx > x > h$$
$$b\beta > \beta > v, \qquad d\eth > \eth, \qquad g\gamma > \gamma$$

I discussed above the voiceless and un-aspirated plosives *p, t,* and *k* as if they had also been "aspirated." I believe that is how it was in the case of speakers of the U/FU protolanguage: they did not hear (probably only allophones also in the Proto-Germanic) distinctions $p\Phi - p$, $t\underline{p} - t$, and $k\chi - k$. For them, all of the voiceless plosives of the IE protolanguage were more energetically pronounced than theirs. That is they were also "aspirated."

The following forms are examples of the "aspiration part" of Grimm's Law.[37] In the forms in parentheses, the "aspiration" of plosives is marked as a frication. Based specifically on these forms, a generalization can be made that the "aspiration part" of Grimm's Law is actually simply an "omission of the occlusion of the plosive."

IE *por (*pΦor-/pfor-)
IE phoino (pΦoino-/pfoino-)
IE tu (*tpu)
IE trekho (*tprekho)
IE kap- (*kχap-/khap-)

Latin nebula (IE *-bβ-)
IE medhjos (*medðjos)
IE steigh- (*steigγ)
Old High German faran

[37]Krahe 1960, pp. 81-83 and 90-91.

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Old High German feim
Gothic þū
Gothic þragjan
Gothic heffen
Old High German neβal
Old Norse miðr
Old High German stīχan

Many linguists who are accustomed to accounting for only borrowing, rather than language shift, in the language contact may wonder how it is possible that voiceless fricatives emerged in the Proto-Germanic as a result of the U/FU protolanguage influence although the U/FU protolanguage itself did not have this kind of consonant. This is, however, not rare in the language change situations. Therefore, for example, Thomason and Kaufman emphasize in their book[38] that especially the substrate from the language being assimilated into the surviving language may well possess phonetic qualities that do not exist in the assimilated language. It is essential that the oppositions of the three sets of plosives of the IE protolanguage (voiceless plosives, voiced plosives, and plosives that are both voiced and aspirated) survived through every phase of the emergence of the Proto-Germanic, that is during the U/FU > IE language shift.

When the "aspiration part" of Grimm's Law is interpreted as having originated as a recognition- and pronunciation mistake on the part of U/FU protolanguage speakers, it is worth noting that a similar mistake occurred again when the next sound shift (*die zweite/hochdeutsche Lautverschieburg*) occurred about AD 500-700;[39] for example, compare Dutch *schip* – German *Schiff*, English *that* – German *dass*, and Swedish *sak* – German *Sache*. This sound shift can also be interpreted as the loss of plosives' (more correctly, affricates') occlusion (more correctly, the plosive part) so that only "aspiration" (more correctly, affrication) was left. Also, this sound shift must have been a learning mistake of those learning a foreign language. This phenomenon started in southern Germany and may have originally occurred when the Celts changed their language for the Old High German. At least this shift was not based on

[38]Thomason–Kaufman 1988, p. 62.
[39]König 1978, p. 63.

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mistakes made by the U/FU protolanguage speakers. Another sound shift has, however, importance also for Grimm's Law: It is known that sound shifts are sometimes repeated in the history of a language. (That the frication of the dental plosives were sibilant, and not spirant – that is t first developed into tp according to Grimm's Law and ts after the second sound shift – does not have decisive importance. The difference between these two developments is that in the development occurring according to Grimm's Law, the tongue tip is pressed (looking from the front / front view) evenly close to the alveoli, but in the development occurring to the second sound shift, the tongue tip formed a groove.

In many cases, these voiced fricatives created by Grimm's Law (bβ > β, d$\eth$ > $\eth$ and gγ > γ) later developed into voiced plosives (β > b, $\eth$ > d and γ> g).[40] This was common especially in regions where dialect later developed into Old German.

The voiceless plosives p, t, and k did not, however, develop into corresponding voiceless fricatives Φ/f, þ, and χ/ h according to Grimm's Law if they were immediately preceded by another voiceless obstruent such as s, p, t, or k, for example, the Latin *mis̲cēre* – Old High German *mis̲kan* and Latin *oc̲tō* – Old High German *aht̲o*. This "exception" to Grimm's Law is a natural result of plosives lacking aspiration/frication when preceded by a voiceless obstruent, and it may be a universal tendency. As a result, aspiration does not occur in corresponding cases in modern English, for instance. For example, compare English *sp̲y, st̲ay, sk̲y,* and *act̲or* in which voiceless plosives are usually unaspirated.

4b. Voice

The devoicing part (b > p, d > t, g > k) of Grimm's Law can also be considered a U/FU substrate because plosives of the U/FU protolanguage did not have voice opposition. Therefore, speakers of the U/FU protolanguage recognized all of the voiced plosives (b, d, and g) as corresponding "normal" plosives (p, t, and k) while learning the Proto IE. The "normal" here refers to those plosives that are unmarked /not identified in respect to voice. The Finns have the same difficulty in learning plosives even today: for example, they often use pronunciations *parpaari* and *kolkata* instead of *barbaari* and *Golgata.*

The following forms are examples of the devoicing part of

[40]von Schmidt 1969, p. 35.

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Grimm's Law.[41]

Greek	*bait*
IE	**dem-*
IE	**aug-*
Gothic	*paida*
Gothic	*timrjan*
Gothic	*aukan*
Latin	*labium*
Latin	*kardia*
Latin	*genu*
Swedish	*äpp*
English	*heart*
Swedish	*knä*

To summarize, we can claim that Grimm's Law as a whole (both its "aspiration part" and its "devoicing part") can be interpretred as hearing- and pronunciation mistakes made by the speakers of the U/FU protolanguage learning the IE protolanguage. It is worth noting that no "pushing" or "pulling" explanations are needed in Grimm's Law to explain that changes in certain group of plosives (for example, the devoicing of b, d, and g) would start changes in some other group (for example, fricatization of p, d, and g). When Grimm's Law is interpreed as a U/FU substrate, no "push- and pull explanations" are needed.[42]

5. Verner's Law

Verner's Law is "an exception to Grimm's Law" ("*Eine Ausnahme der erstem_Lautverschiebung*"). According to this law, the voiceless obstruents (plosives and s) become voiced (they do not remain voiceless as they should have according to Grimm's Law) when occurring in a voiced surrounding after an unstressed syllable; for example, the voiceless plosive *t* of the Indo-European word **pot'er* became voiced (compare Swedish *fader* and English *father*). My explanation for Verner's Law (which in this form only deals with part of Verner's Law, as is shown below) is as follows: When the stress shifted to the first syllable

[41]Schmidt 1969, pp. 35-36 and Krahe 1960, pp. 91-92.
[42]König 1978, p. 45.

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of the word, two operations had to occur: the word-initial syllables had to be strengthened, and the syllables immediately following the originally stressed syllables had to be weakened. Both of these operations were needed so that the stress could have been perceived as shifted to the first syllable. The latter process did not easily achieve its goal (it was not easy to start realizing the previously stressed syllables as unstressed ones) if the syllable began with a voiceless obstruent. This is because voiceless obstruents are intrinsically relatively long and the voiced sound following them has a high fundamental frequency (voiceless obstruents raise the fundamental frequency of voiced sounds following them). It is more difficult to perceive elongated syllables with high fundamental frequency as unstressed than other syllables because they are perceived as stressed easier than others. A special operation must be performed in these "difficult cases." A voiceless obstruent must become a voiced one, for example, *pə̬t̲'er* > *pə̬d̲'er* / *pə̬ð̲'er*. This operation shortens the syllable and lowers its fundamental frequency, therefore, making it easier to perceive it as an unstressed one. (This is also explainable from the articulation point of view because the voiceless obstruents are intrinsically "more energetic" than the voiced ones, and the syllables that include more sounds that demand more articulation energy are more easily perceived as stressed than other syllables.)

The above mentioned "weakening of syllables that are difficult to perceive as unstressed ones" is, however, only one part of Verner's Law. The other part deals with the general pronunciation of the unstressed syllables: segments of unstressed syllables are usually "weakly" pronounced. This means that vowels are pronounced as short, they have a centralized (*a* like) quality, and they are more susceptible to assimilation by strong environment. The same is true with consonants. They are also short, have "unclear" qualities and are susceptible to become assimilated by their environment. "Weak" pronunciation of consonants means, more specifically, for instance, that voiceless obstruents (when in voiced environment) become voiced. This is exactly what happened according to Verner's Law. For example, IE **wrtonós* Modern German *geworden*- in which *t* became voiced (although it may have later become voiceless again; compare with Old German *giwortan*).

The above discussion shows that Verner's Law consists of two

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parts. The voiceless obstruents are made voiced in: a) syllables that are physically "too powerful" and difficult to perceive as unstressed; b) between two unstressed syllables (more correctly, at the beginning of a following unstressed syllable). The two parts have, therefore, quite different motivations. In one we deal with "too much strength" and in another with "lack of strength."

There are four theoretically possible sequences of strong and weak syllables:

1	2	3	4
cv.CV	cv.cv	CV.cv	CV.CV

Verner's Law makes the voiceless obstruents voiced in cases 1 and 2 but not in cases 3 and 4. It is easy to see that the traditional way to define the environment ("after an unstressed syllable") of Verner's Law and my somewhat more complicated proposal according to which the Law operates in two different cases, "a too powerful syllable following a weak syllable" and "between two weak syllables" are identical. My two-part Verner's Law is more complicated, but it probably takes into account motivations of the phenomena better than the traditional one.

The two parts of Verner's Law (cases cv.CV and cv.cv) resemble the Baltic-Finnish languages' Consonant Gradation, which also includes two parts: "radical" and "suffixial"; compare, for example, *äiṯin puuroṯa* (mother's porridge), in which *t* in the first word is weakened because it occurs at the beginning of a "too strong" (closed) syllable, and *t* in the second word is weakened because it occurs in a sequence of two weak syllables. The Consonant Gradation was introduced in the Baltic-Finnish from the Proto-Germanic and/or Proto-Scandinavian/Nordic languages during the Bronze Age and/ the Roman Iron Age. It was like "returning an old loan."

It is worth noting that, according to the solution to Verner's Law presented by me, the voicing of obstruents and the stress shift are actually one and the same process, and it does not make sense to consider one either older or younger than the other. According to this solution, the voicing of obstruents is simply part of the stress shift, one of the prerequisites that had to be fulfilled so that the stress shift could have occurred.

6. Places of Articulation of Plosives

The plosives of the IE protolanguage had four (five,

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according to some sources) places of articulation, while the U/FU protolanguage had only three. The difference resulted in the speakers of the U/FU protolanguage not hearing the difference between the palatal and velar (more correctly, labio-velar) places of articulation; they were unable to hear "two *k*:s" and two *g*:s; therefore, they were unable to hear, for example, *g*-plosives of the IE words **aug-* "to add" and *g^{w}en* "wife" as different, but instead they heard the same plosive in both cases. It is assumed that *k* of U/FU protolanguage was in respect to its place of articulation similar to the *k* of modern Finnish, which has two places of articulation – palatal and velar – so that the palatal *k* occurs with the front vowels and the velar one with the back vowels. If this was really the case, the speakers of the U/FU protolanguage who were learning the IE language had to split their own phoneme in two. This task is often too difficult.

7. Palatalization of Consonants

By palatalization of consonants, I mean here that speakers of U/FU protolanguage had over-differentiating ears to distinguish palatalization in IE language because the U/FU protolanguage had the opposition of palatalized and unpalatalized consonants. The IE protolanguage did not have this opposition, but it is probable that the consonants were somewhat palatalized (F1 low and F2 high) when they occurred next to *i* or *j*. This is common in languages even if they are not palatalized phonetically. The speakers of the U/FU protolanguage heard the "lightly palatalized" consonants, and when speaking the IE language, they also clearly palatalized them. The situation is like this today when Russians (whose language includes palatalization of consonants) hear and speak Finnish: for example, they hear consonants of the word *hyllyllä* (phonetically *hüllüllä*), which are only slightly palatalized by the Finns, as clearly palatalized and pronounce them like they pronounce strongly palatalized Russian consonants. (I assume here that speakers of the U/FU language tended to hear all of those consonants palatalized, which were immediately preceded by *i*/*j*, although in their language the phonetic palatalization appeared only in dental consonants.)

The palatalization of consonants appears commonly not just in consonants themselves but also in neighboring vowels. They exhibit "palatal transition," that is, the transition between a

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vowel and a palatalized consonant is somewhat *i*-like (during the transition, F1 is lower than usual and F2 is higher than usual). For example, pronunciation of *lat'* may in this case sound like pronunciation of *lait'* (that is, a back vowel preceding a palatalized consonant sounds like a diphthong ending with *i*) or, if the palatal transition is longer and comprises a large part of the vowel in question, the pronunciation may sound like *lät'*. When considering that there were palatalized consonants in the Proto-Germanic due to over-differentiation in the U/FU protolanguage, we can explain many sound/phonetic phenomena of the Germanic languages. These phenomena may have already started in the Proto-Germanic, but many of them have become phonemic only much later, commonly during the period AD 500-1000. I will next discuss five of these: *i*-umlaut, monophthongization of *ei*-diphthong, $e > i$ vowel change, *u*-umlaut, and diphthongization (breaking) of vowels. I argue that all of these phenomena are ultimately based on the palatalization of consonants in the Proto-Germanic.

7a. i-umlaut

It is commonly thought that the *i*-umlaut developed in the Proto-Germanic languages only after the Proto-Germanic period. One reason for this interpretation is that the *i*-umlaut does not exist in East Germanic; it only exists in North-and West Germanic. Besides, it can be proven that forms like *i*-umlaut did not start appearing in Proto-Scandinavian until AD 550-1050,[43] although a few appeared already in the Proto-Germanic loan words adopted in Finland during the Bronze Age; compare, for example the modern Finnish *kärsiä*, the Germanic forms of which are, according to the traditional view, **harðian* and **wurkjan*, but the vowels in the first syllables may be deduced in light of Finnish identification to have become articulated more toward the front (more like front vowels). Therefore, I argue that the seed of *i*-umlaut already existed in Proto-Germanic. Its existence was based on three distinctive features of the U/FU protolanguage (or at least on some of them): 1) the palatalization of consonants, 2) vowel harmony, and 3) the fact that the vowel system of the U/FU protolanguage included front vowels *ü* and *ä* corresponding with *u* and *a* (but these did not

[43]Haugen 1978, p. 153.

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exist in the IE protolanguage).

1) The over-differentiation of palatalization based on the palatalized consonants of the U/FU protolanguage resulted in the back vowel preceding the palatalized consonant first received a palatal end transition after which the whole vowel started to be pronounced as a front vowel (compare with the above discussed example *lat'* > *lait'* > *lät'*).

2) The result of the U/FU protolanguage's vowel harmony was that there could not be a back vowel in the same word with the front vowel *i*, but only a front vowel. For example, the form *handi-* contradicted the vowel harmony, but the form *händi-* did not. The vowel harmony pairs of the U/FU protolanguage were *i – ï, ü – u, e – o,* and *ä – a,* and, for example, the front vowel *i* can appear in the same word with vowels *i, ü, e,* and *ä,* but not with vowels *ï, u, o,* and *a.* It is possible that the U/FU protolanguage speakers pronounced a kind of "intermediate vowel" in words that break vowel harmony (for example, as the first syllable vowel in the form *handi-*). This "intermediate vowel" was not a pure front vowel nor back vowel. (This also happens often today when a Finn forces himself to pronounce the word *olümpia,* for example. Instead of pronouncing a pure *o* or *ö,* he pronounces an intermediate vowel of these two in the first syllable). Later (when the U/FU substrate escalated and *i* disappeared), the "intermediate vowel" became an independent phoneme and a normal front vowel.

3) Also, because the U/FU protolanguage's vowel system included two front vowels *ü* and *ä,* which were ultimate end results of the *i*-umlaut (but which do not exist in the IE protolanguage) had influenced for their part that this kind of vowels (and also *ö*) started to appear in words including *i*-umlaut.

The centralization of stress can be presented as the fourth common reason for the origin of *i*-umlaut: when the stress became centralized and the stressed syllable became stronger at the expense of the unstressed ones, *i/e* following the stressed syllable started to become weakened and even disappeared, leaving *i/e*-like qualities, that is palatalization, in the preceding consonant as a legacy.

The phonetic qualities of the U/FU protolanguage which influenced the origin of the *i*-umlaut can be dissected even

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more deeply: perhaps palatalization of consonants resulted in palatal transition in a preceding consonant (the vowel becoming a diphthong ending in *i*), and perhaps the vowel harmony as well as the existence of monophthongs *ü* and *ö* in the U/FU protolanguage's vowel system had the result that the whole palatalized diphthong-like vowel started to become recognized as a front vowel. Thus, the first mentioned reason resulted in the development of *lat'* > *lait'*, and reasons two and three resulted in the continuing development of *lait'* > *lät'*. (I will not discuss here that the *i*-umlaut often became phonemic only when the palatalizing *i/j* forms disappeared.

The following forms are examples of *i*-umlaut in Proto-Scandinavian (the front vowels resulting from umlaut are all marked with two dots regardless of how the vowels are traditionally marked)[44]:

ungiRā	>	*üngRe*	younger
kǫmiR	>	*kömR*	comes
katilaR	>	*kätilR*	kettle

7b. Shortening of the Diphthong ei *into* i

The diphthong *ei* shortened into *i* maybe already during the Proto-Germanic phase or soon after it; compare, for example, Greek *steĭkho* and Proto-Scandinavian (Old Norse) *stīka*. This sound shift can be interpreted as a kind of first step of *i*-umlaut: *i/j* probably resulted in some degree of palatalization of a preceding consonant in the IE protolanguage (as in languages in general), which became then enforced as a result of palatalized consonants of the U/FU protolanguage. However, contact assimilation is usually a more common phenomenon than distant assimilation. The assimilation may at first start as a contact assimilation and later develop into a distant assimilation. In addition, a more or less universal feature of an assimilation is that it first influences sounds most similar to the sounds functioning as assimilators, and the assimilation later expands to influence also sounds which have phonetic qualities even more distinct from that of the assimilator. If this principle also applies to *i*-umlaut, this phonetic phenomenon started so that the assimilator *i/j* first influenced only immediately adjacent sounds and in addition only those sounds that had as similar qualities as

[44]Haugen 1978, p. 153.

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possible with *i/j*. The diphthong *ei* was exactly this kind of case: its *e* immediately preceded *i*, and *e* was *i*'s neighbor vowel based on its qualities.

7c. Vowel Shift e > i

The sound shift *e* > *i* occurred in the Proto-Germanic or after it, if the following syllable included *i* (and, in addition, also if the following syllable included *u* or if *e* was followed by a consonant combination starting with a nasal); for example, Latin *medius* – German *mitten* and English *mid*, Latin *pecus* – Old High German *fihu* (modern German *Vieh*) and IE **wentó* (Latin *ventus*) – modern German *Wind*.[45] This sound shift can be interpreted as the next step in development of the *i*-umlaut: Now the influence of *i* has, however, already developed from contact assimilation to distant assimilation, but *i* still only influences a sound that is its closest phonetic neighbor. Therefore, we are dealing with *i*-umlaut, which only deals with *e*, but not yet other vowels. (The shift/change which shows, for example, in other word forms, such as *medius – mitten / mid*, may be Celtic substrate.[46])

7d. Diphthongization of some Monophthongs

Diphthongization of monophthongs took place both in the northern and the western territories of the Germanic languages, for example, approximately during AD 500-1000 in the Scandinavian protolanguage *erðu* > *iarðu* (modern Swedish *jord*)[47]; compare also Gothic *hēr* > Old High German *hear / hiar / hier* (here).[48] The seed of this phenomenon (breaking in English and *Diphthongierung* in German) may also have already existed in the Proto-Germanic because it could also be based on the palatalization of consonants of the U/FU protolanguage. When palatalization of consonants occurs in languages, this opposition is not usually between the palatalized and "normal" consonants, but between palatalized and (at least to some extent) velarized consonants. At least in that phase where only one of the vowels *i*, *e*, and *u* was able to exist in unstressed syllables, the preceding consonant had three types of allophonic qualities: *i*-like, *u*-like, or *a*-like. That is, it included as secondary qualities

[45]Rooth 1962, p. 128 and Keller 1978, p. 78.
[46]Keller 1978, p. 128.
[47]Haugen 1976, p. 153.
[48]König 1978, p. 65.

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palatalization, labio-velarization or pharyngelization. These, for their part, (as was already presented in the case of palatalization) caused a labio-velar (*u*-like) or pharyngeal (*a*-like) end transition. Of a vowel preceding a consonant. In other words, vowels may have received either an *u*-like or *a*-like (in any case back vowel-like) end transition. That is they may have become diphthongized.

7e. a- *and* u-*umlaut*

Although *a*- and *u*-umlaut did not yet exist in Proto-Germanic, I believe that the seed of this sound phenomenon already existed in the Proto-Germanic. Also, this phenomenon escalated with time as the IE > U/FU language shift moved toward the north. In a similar way to the expression of *i*-umlaut as a vowel's *i*-like end transition (diphthong) before the whole vowel became a front vowel (*lat'* > *lait'* > *lät'*), also the influence of *a* and *u* was able to expand from a mere end transition (diphthongization) of a vowel to make the whole vowel *a*-like and *u*-like (or the vowel was diphthong-like so that its final part became more *u*-like or *a*-like; this phenomenon is called "breaking"). This happened, for instance, in Proto-Scandinavian. The phenomenon is called *a*- and *u*-umlaut. Examples:[49]

wiraR > *weraR*	'man'
hurna > *horna*	'horn'
teguR > *tögR*	'ten'
barnu > *bǫrn*	'children'

8. Dissolution of Syllabic Resonants

The IE protolanguage had syllabic resonants, that is resonants forming syllables; for example, IE **kmtón* – Gothic *hund* (hundred) and IE **bhrtis* – Old High German *gi-burt.*[50] There was no opposition between syllabic and non-syllabic resonants because those resonants with sonority higher than that of their environment (that is those which are located, for example, between two obstuents, or between an obstruent and the word's boundary) were automatically syllabic. The U/FU protolanguage hardly included syllabic resonants and, as a

[49]Haugen 1976, p. 153.
[50]König 1978, p. 47.

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result, it was difficult for speakers of U/FU protolanguage to pronounce them. They replaced them with a vowel *u* and a sequence of resonants in question. That is, they pushed an "extra" (epenthetic / protethetic) *u* in front of the resonant to make the pronunciation easier. Of course, there is no proof that speakers who avoided syllabic resonants in this way were specifically U/FU protolanguage speakers. Syllabic resonants are relatively rare in languages. Therefore, speakers of some other ancient language than U/FU protolanguage could have influenced the dissolution of syllabic resonants. Because the syllabic resonants are universally relatively characteristic, it is not impossible either that the dissolution of syllabic resonants resulted from an intralingual process.

Before discussing vowel changes occurring in the Proto-Germanic in more detail, it is necessary to look at the vowel systems of the IE- and U/FU protolanguages:

IE: Short vowels:

i		*u*
e	*ə*	*o*
	a	

Long vowels:

í		*ú*
é		*ó*
	á	

U/FU: Short vowels:

i	*ü*	*ï*	*u*
e			*o*
ä			*å*

Long/Double vowels:

ii	*uu*
ee	*oo*

The vowel systems were, therefore, different in many respects: The general form of systems was different (IE

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protolanguage's vowel system was triangular-shaped, U/FU protolanguage's vowel system was square-shaped), the number of phonemes was different, and also systems included different distinctive features. (I do not mark here long vowels with an elongation symbol on top of the letter in case of the IE protolanguage and with a double letter in case of the U/FU protolanguage). The vowel system of the U/FU protolanguage influenced the vowel system of the IE protolanguage resulting in the vowel system of the Proto-Germanic language provided below:

PG: Short vowels:

i *u*

e

a

Long vowels:

í *u*

é *o*

Developments were especially influenced by three changes: a) merging of vowels *∂* and a of the IE vowel system to *a*, b) merging of short *o* and *a* to *a*, c) merging of long *o* and *a* to *o*.

9. Merging of ∂ and a *to* a

The U/FU vowel system did not include a "schwa indogermanicum" or "neutral vowel." If this vowel still existed in the IE language during the period when speakers of U/FU language were learning the IE protolanguage, they did not have a chance to "correctly" recognize this vowel; they recognized it as the closest equivalent in their own language, or the vowel *a*. It is, however, possible that vowel *∂* no longer existed in the IE protolanguage during this period, but that it had already earlier merged with *a*; possibly before IE and U languages came in contact with each other. For example, the form *pa̲∂t'er* of the word father had developed into the form *pa̲t'er*.

10. Merging of o *and* a *to* a *and 11. Merging of* ō *and* ā *to* ō

The most important differences between the IE and U/FU vowel systems dealt with the *o*-like and *a*-like area of the vowel diagrams. The U/FU speakers learning the IE language were

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unable to differentiate *o*-like and *a*-like vowels of the IE protolanguage for the following reasons: a) their own open back vowel was labial *å* (not illabial *a* like the most open back vowel of the IE system), b) their own system of long vowels had two degrees of openness including (according to the traditional system) only the long back vowels *uu* and *oo*, not *aa*, but the system of long back vowels of the IE protolanguage had three degrees of openness including also *ā*.[51] It is worth noting that in languages in which even the most open back vowel is labial, labialness and backness are not (at least in case of back vowels) independent features, but they form a single undivided feature /labial+back/. A speaker of this kind of language cannot consider back vowels' labialness and backness as independent features. The system of U/FU protolanguage was exactly this kind of language. When speakers of U/FU language had to deal with the IE vowel system in which /labial/ and /back/ were two distinct features (or which included labial *u* and *o* and illabial *a*), they were unable to differentiate these features from each other; they had to consider /labial/ and /back/ as a single, undivided feature. The result was that their back vowels used when speaking an IE language were labial: They used *å* instead of the correct IE form *a*. Because there was hardly a large difference of quality between the most open back vowels of the U/FU system, (short) *å* and (long) *oo* (both of these were open and labial), the mistake was hardly considerable if *å* was used as a symbol of quality for both. In this case, back vowels used by U/FU protolanguage speakers when using IE language were, therefore, *u-o-å* and *u-a*. As such, the system was exactly the same as the one Keller postulated for the Proto-Germanic:[52]

Short vowels:

i *u*

e *å*

Long vowels:

í *ú*

é *å*

[51]Janhunen 1981.
[52]Keller 1978, p. 78.

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According to the solution I have presented, this inability to differentiate the vowels [*a*+*o*] > /*å*/ at first dealt with both short and long vowels. Why then, however, did the vowel *å* develop differently in the systems of short and long vowels? In the case of short vowels, *å* became *a*, but in the case of long vowels it became *o*. The answer is found in what else occurred in neighborhoods of *o*-like and *a*-like vowels of the Germanic vowel diagram:

a) The phoneme area of the closed back vowel *u* started to expand toward *o* in the Proto-Germanic when an open (*o*-like) allophone developed for *u* in those cases where *u* was followed by *a*, $\bar{e}^1$, *o* in the next syllable. This "*a*-umlaut" is represented, for example, by Proto-germanic *wulfa* – which developed in the West Germanic at the latest to form *wolf(a)* and modern German *Geburt – geboren* variation.[53] The *o*-like allophone of phoneme /*u*/ developed into an independent phoneme /*o*/ and, in this way, the system of short back vowels regained its three degrees of openness. Because the most open vowel of the system with three degrees of openness has rather *a*-like than *å*-like qualities, the short vowel of the Proto-Germanic which is marked with letter *å* ahead lost it labialness and became *a*. (Now, also the undivided distinctive feature /labial+back/ was divided into two independent features /labial/ and /back/. This division may have been influenced the case b discussed ahead in which an illabial vowel developed to the most open long vowel).

b) In long vowels, the Proto-Germanic $\bar{e}^1$ (which was based on the *ei* diphthong of the IE protolanguage) developed to *a*; for example, the Proto-Germanic $\bar{e}^1$ developed to form *atum* (and later to Old High German *assen*). After this shift, the long back vowels were *ū-å -ā*. According to the principle of phonemes' equal distances (ekdistanssi), a more natural system of back vowels with three degrees of openness is, however, *u-o-a*. It is, therefore, natural that the central vowel of the series slid to the middle of the back vowels' degree of openness scale. That is, it became *ō*.

These two sound shifts, *u* > *o* and $\bar{e}^1$ > *a*, which I consider to have caused short and long *å* of the Proto-Germanic to develop

[53]Rooth 1962, p. 130 and Keller 1978, p. 80.

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differently (the short one becoming *a* and the long one *o*), may be considered with suspicion because the "opening of *u*" and the "openning and increased backness of $\bar{e}^1$" are too recent phenomena to have been able to cause the two types of development of *å* discussed. It is, however, worth keeping in mind that changes dealing with *u* and e^1 may have existed as allophonic phenomena already during the very early stage of Proto-Germanic.

The fact that short and long *å* developed in different ways is seen, for example, in the words "go" and "mother": IE **por* – Old High German *faran* and IE **māter* – Scand. *moðer* "mother."[54]

12. Apocope of a *and* e

A deletion of *a* and *e* ending a word occurred in the Proto-Germanic at the latest; compare Proto-Germanic *wait*, which was either *waita* "I know" or *waite* "he knows" in its earlier stage.[55] We may be dealing with a reflection of the centralization of stress: When a stressed syllable became increasingly stressed, unstressed syllables weakened and their vowels may have disappeared. Because the centralization of stress was based on the U/FU influence, also this phenomenon can be considered as an indirect U/FU influence. More recently (especially during AD 550-1050), apocope became more widespread and varied in form.

Conclusion

I have presented more than ten sound phenomena that could be learning mistakes made by U/FU speakers when they were learning an IE language during the period 3500-2800/2300 BC somewhere in the region of North Germany-Denmark-Skåne and further north. I discussed these sound phenomena to demonstrate that speakers of U/FU language had at some point really changed their U/FU language to that of an Indo-European one and that for this reason they had a significant role in the birth of the Germanic languages (differentiation of the Germanic languages from other IE languages). What if one of these phenomena can be demonstrated to be invalid? That would not have any significant

[54]König 1978, p. 47.
[55]Haugen 1976, p. 103.

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importance to the big picture because it is sufficient that even *one* of these sound phenomena I have proposed is demonstrably a U/FU substrate in the Proto-Germanic.

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Using DNA to Help Solve the Riddle of Ancient Germanic Migration

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The author shows how improved techniques for the use of DNA in archaeological research can now be used to investigate the legendary and linguistic evidence that suggests southern Scandinavia as the original homeland of the Goths, Vandals and other Germanic peoples who played such a major role in the Folkwandering period of European history.

Key Words: DNA research; Germanic Folkwandering; Scandinavian history; Scania; Gotland; Bornholm; Jutland; Goths; Vandals; Jutes; Langobards.

Introduction:

Migration from South Scandinavia

The migration of the Goths from South Scandinavia, perhaps the most prominent of the East Germanic peoples, is described in Getica (25-27) by Jordanes as a coming forth from Scandza, a hive of races or a womb of nations, under their king Berig. When landing on the Polish coast at the mouth of the River Vistula, they named the place Gothiscandza. Jordanes states that they sailed in three ships, one of which was manned by Gepids, and the two other by Goths. But this may represent a distortion of the historical fact, since this would represent very small numbers of migrants.

The general view has been that both the Gepids and the Goths came from the provinces of Västergötland and Östergötland in the southern part of the Scandinavian Peninsula and/or the Island of Gotland in the Baltic Sea.

The tribal designation of the *gøtar* (the inhabitants of the Götaland region of southern Sweden) is closely related to the designations Goth (*gutans*) and Old Swedish *gutar* (Gotlanders) as well as to the names Västergötland, Östergötland and Gotland). However, archaelogical research in south Scandinavia and northern Poland has so far failed to establish clear links

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[2] Ulf Berigsen is a Swedish jurist and author who has written extensively on the ancient Germanic peoples and their migrations during the Folkwandering period, and most notably between 200 BC and 300 AD.

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between Gauts and Gotlanders on the one hand and continental Goths on the other.

There were also other possible migrations from South Scandinavia. Vendsyssel, the northern area of the Jutland peninsula, has been regarded as original home of the Vandals, who are believed to have given their name to Andalusia before founding a kingdom in North Africa during the Fifth Century AD. According to the *History of the Langobards* by Paul the Deacon, the Lombards originated in "Scadinavia," which has been interpreted as Skåne Province (Scania) in southernmost Sweden. Furthermore, the Burgundians have been thought to originate on the island of Bornholm (earlier named Burgundarholm) in the Baltic. The elusive Eruli (in this case the Eastern Eruli) joined the Goths in the Black Sea area in attacking Asia Minor and the Eastern Mediterranean in the Third Century AD (The World Crisis of the Third Century AD). Some of these returned to Scandinavia to settle near the remaining Gauts, according to the historian Procopius. There are further examples of migration out of Scandinavia, but those mentioned above are the most prominent.

In the 1990s, Nordgren, a Swedish scholar, in his book *The Well Spring of the Goths*, expressed the view that the names of the Gothic peoples are theophoric and seem originally to have been linked to the creator-god, Gaut. Gothic ethnicity could thus have been founded on a common cult with its religious origin in southern and southwestern Scandinavia, an area also embracing Jutland.

DNA studies have provided convincing evidence of the history and origin of diverse peoples, notably of the Jewish diaspora, and could well be utilized to test the validity of the presumed links between Scandinavia and Goths, Vandals, and Langobards.

Recent Developments in Molecular Biology

DNA (deoxyribonucleic acid) is the master molecule of a cell. It can, among other things, trace human migrations. The use of DNA in archaeology is only a decade old. Swedish researcher Svante Pääbo of the University of Munich has called it the greatest archaeological excavation of all time.

The first ancient DNA was isolated and duplicated in 1984 from a quagga, an extinct zebra, in a museum collection in

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Germany. In 1985 Pääbo extracted human DNA from an Egyptian mummy from the first millenium before B.C. This was earlier believed impossible because ancient DNA is very fragmented and preserved soft tissues are rare, but there were scientific breakthroughs in the late 1980s. First the polymerase chain reaction (PCR) was discovered, an easy method for generation of unlimited copies of any fragment of DNA. Today, PCR-machines cost little and are of a size making them easy to handle.

Then research groups in England, Japan, and France recovered DNA from preserved bones and teeth. Such material can be found in most ancient graves.

Most archaeological DNA research uses mitochondrial DNA (mtDNA). These are tiny structures in each cell supplying energy for metabolism. Mitochondrial DNA is distinct from DNA in the cell's nucleus, and one cell can contain thousands of mitochondria. Thus mtDNA can often be recovered from bones. Nuclear DNA, by contrast, only exists in two copies in each cell.

MtDNA is also less complex to investigate. It has 37 genes while nuclear DNA has between 60,000 and 100,000. Mammalian mtDNA is inherited only through the maternal line. But research can also be conducted using DNA from the Y chromosome, which is inherited only from the father.

The use of extracted mtDNA is quite simple. A PCR is used to copy part of it (a sequence), and a comparison is then made of the result to other DNA sequences to identify the population the sample came from. Probably the most dramatic achievement so far has been the extraction of DNA from a bone of a Neanderthal by a team of American, German and Swedish scientists[3]. As a result of this achievement, it was concluded that Neanderthals and modern humans diverged genetically far earlier than believed – probably more than half a million years ago.

First, the research team confirmed that the DNA samples available were of Neanderthal origin by testing them against human samples and found no reaction. Then the Neanderthal DNA was compared against a group of both human and common chimpanzee sequences. The differences in

[3] Lee Bowman, "DNA Analysis Separates Neanderthals From Man," Scripps Howard News Service, July 11, 1997.

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Neanderthal DNA occurred at sites of the sequence where differences are usually found in both humans and chimpanzees. Later comparisons were made with mtDNA lineages of Africans, Europeans, Asians, Native Americans, Australians and Pacific Islanders. A match was missed with the Neanderthal by 27 or 28 genetic base pairs out of a sequence of 378.

The researchers have warned, however, that the results are based only on DNA from one individual Neanderthal, and there might be other contributions from the Neanderthals to the human nuclear genetic material than the test reveals.

Ancient DNA has also been reported from skins of up to 13,000 years old (Pääbo 1989), mummified soft tissues from up to 5,000 years old (Pääbo 1989), and brain tissue preserved in neutral bogs 7 – 8,000 years old (Pääbo 1989). Bone and teeth are, of course, the most commonly surviving material from the past.

British Research

Much of the reseach done until the middle of the 1990s has not been relevant to continental European history and archeology. Some work has been conducted relevant to Anglo-Saxon and British populations in England. The end of Roman Britain and the migration of Anglo-Saxons to Britain have been studied.

Attempts were made in the 1990s to distinguish Britons from Anglo Saxons in Migration Period cemeteries on the basis of DNA samples collected from skeletal material (Richards 1995). These samples were compared with ones from modern populations in northwestern Germany, Denmark ("Germanic") and north Wales ("British").

Richards-Sykes warned in 1995, however, that initial studies suggest that more than 50 percent of skeletal remains from the past two thousand years are likely to contain amplifiable endogenous DNA, but that human material can be contaminated before the samples reach the laboratory (Richards 1995:291).

> We have amplified about a dozen Anglo-Saxon and Roman-British samples from cemeteries at Finglesham, Berinsfield, Catterick and Ipswich, using one or both pairs of primers in the first hypervariable segment of the control region, with the aim of characterising the early Saxon population. The bones were

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in general of poor micromorphology and were difficult to amplify reproducibly using 40 cycles of PCR, although the best preserved sample histologically was also the most reproducibly amplifiable (Richards 1995:295).

Russian Research

In the 1990s, research was conducted on skeletal material in Northwest Russia in respect of Scandinavian migration by Nordic settlers into the quadrant Lake Ladoga, the upper parts of the Volga, Lake Ilmen and Lake Peipus. The Russian population in the quadrant today has more physical-anthropological similarities with the population of East Sweden than with the rest of the population in Russia (Kan 1996:24)[4].

Another source mentions osteological research of skeletal remains of the churchyard of St. Clemens in the Ladoga village. The results show a Scandinavia anthropological type among local inhabitants (Anderson-Birkebaek 1993:74).

Lombards and Ostrogoths in Italy

As mentioned above, according to Getica (Jordanes, 1908) and *Historia langobardorum* (Paulus Diaconus, 1907), the Goths and Lombards are believed to have migrated from southern Sweden; and the Goths from Västergötland, Östergötland or/and the Island of Gotland in the Baltic Sea, and the Lombards from Scania.

Researchers from the University of Bari have since 1989 been comparing Lombard cemeteries in Apulia with both Gothic and Lombard graves in an atempt to determine the influence of Germanic invasion into Italy on the ethnic composition in the Late Imperial period.. The graves are, for instance, at Piano di S.Giovanni (Canosa – Bari), S.S. Trinita church (Venosa, Potenza), the death village of Auricarro (Bari) and a military outpost (Torre S. Susanna, Brindisi). The results show groups with high social status and well fed. The morphometric characteristics of the skeletal remains show a difference from the native context. Some skulls have possible Mongolian origin (perhaps from the Avars absorbed in the Lombardic population).[5]

[4] Research by Dr. M.Vitov.

[5] E-mail from Dr. Sandro Sublimi Saponetti, University of Bari, Italy, in the archive of the author.

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Skeletal Remains in Scandinavia of Relevance

Bog Bodies in Denmark

Mummified bodies found in Danish bogs could be helpful.[6] Around 1,000 bodies or body parts have been found in northwestern Europe from the Iron Age. For some reason the Germanic peoples in these parts of Europe (Netherlands, Germany, Denmark, and Sweden) deposited in lakes or bogs the remains of persons who appear to have been executed. The only existing written account from the Iron Age describes the customs of the Germanic peoples of the time: "The murdered bodies that emerged from the bogs millennia later seemed to confirm Tacitus' judgement. The majority of the bog people had not died of natural causes. Most had been hung – the ropes were still around their necks – hit over the head, or stabbed."[7] Among the Danish finds are the Tollund man, the Grauballe man, the Elling woman, and the Huldremose woman, to mention a few. There is a problem, however, in the fact that the acidic bog water seems to alter certain genetic material; but it remains possible that unaltered DNA can be extracted from the unaffected areas, such as the center of a tooth.

The Cimbri[8], Teutones[9] and possibly the Vandals[10] are believed to have migrated from Jutland.

A Gotland Grave

The remains of Swedish "bog people" are generally not so helpful, since they mostly predate the Iron Age. However, one grave with well-preserved skeletal remains, found in July 1997 in Lau on Gotland, has been dated at around 600 A.D., and could be suitable for DNA research relevant to our proposed

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[6] Shanti Menon, "The People of the Bog," Discovery, August 1997, pp. 60 – 67. See also Wijnand van der Sanden, Through nature to eternity : the bog bodies of northwest Europe, Amsterdam : Batavian Lion International, 1996.

[7] See article of Menon above, p. 64. Tacitus description can be found in Chapter 12 (Tacitus, Germania, Oxford, England: Clarendon Press, 1999).

[8] Tacitus, Germania, p. 82.

[9] The Cimbri of Jutland, Denmark, are believed to come from the modern Himmerland region of Jutland.

[10] The homeland of the Teutones is believed to be the Thy region on the west coast of Jutland, Denmark.

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purpose.[11]

Important Jutland Research:
The Battle of Illerup

The Forhistorisk Museum in Arhus and later Moesgard Museum, Jutland, Denmark, has for the past decades presented the finds from the river valley of Illerup, where 15,000 artefacts have been found in a bog. The excavations are completed and the artefacts will be published and accessible to the public in an exhibition. In the search for explanations and parallels, there are wide possibilities for comparative work.

Analyses of the Illerup finds show a connection between Roman Italy and the bogs of Southern Scandinavia. Other comparisons can be made with Syria, Africa, or Northern England. The overall picture places Illerup in a central position when seeking anwers to questions of early Rome and North Germania. It should be possible to investigate the Illerup and other Jutlandic finds in a more detailed way. DNA analyses will offer a future solution for research on bog material.

DNA and osteological research can also be supplemented by the metallurgic investigation of iron and precious metals. Similarly, the wood remaining of the boards and handles of shields can provide dendrochronological evidence of the date of such remains. One can only hope that the Danish government or private donors will provide funds for a Center for Iron Age Research at Moesgård as soon as possible.

Critics

Recently, some archaeologists have expressed misgivings concerning the "misuse" of genetic analyses for political purposes using ethnicity. They claim that ethnicity is a social construction.

In sociology they point out ethnicity could be the shared (perceived or actual) racial, linguistic or national identity of a social group. Some social anthropologists view ethnicity as primarily a device developed for the maintenance of boundaries. These critics claim that it could be politically dangerous to link DNA with ethnicity, and the authors (Mirza-Dungworth, 1995) paint a bleak picture of DNA analysis being

[11] A fairly common theory places the homeland of the Germanic Vandals in the Vendsyssel region, in the northernmost part of Jutland.

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used to exclude immigrants from a united Europe. Such trends as the ones presented by Mirza-Dungworth are, however, outside the field of history, archaeology, and history. It is hard to understand why politics should be allowed to place constaints on academic research.

Conclusions

With the development of the tools to study ancient DNA, it is now possible to make comparisons between skeletal remains of ancient Germanic peoples in, for instance, Italy, Germany and Scandinavia.

Thus it might be possible to study DNA from skeletal remains of these graves and compare this with DNA from skeletal remains of Iron Age graves in Scania, in Goetaland (Västergötland, Östergötland) and on Gotland. Comparisons could also be made with modern populations in these areas of Sweden using the method applied to compare ancient British and Anglo- Saxon populations. It is possible that the question of the early homelands of many of the migrating Germanic peoples before and during the Era of Great Migration in European history might thus be resolved.[12]

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[12] "Orörd forntidsgrav funnen" (Untouched Ancient Grave Found), Newspaper Svenska Dagbladet, Stockholm, 22 July 1997.

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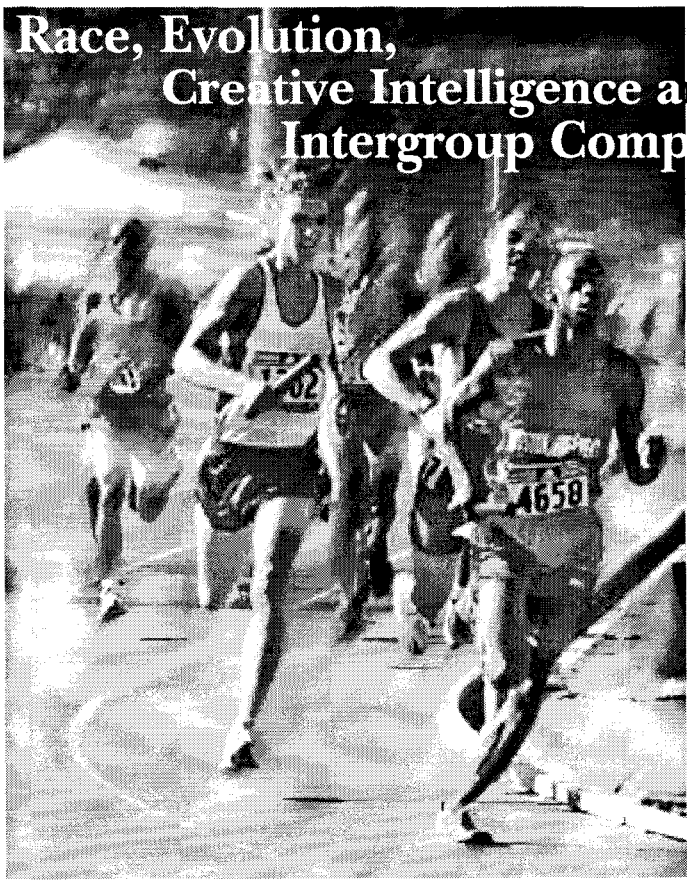
Race, Evolution, Creative Intelligence and Intergroup Competition



Edited by Alan McGregor, five distinguished academics present arguments which support the view that human evolutionary advance resulted from competition between rival populations as well as from competition to reproduce from within breeding pools. Until recent times, it is argued, the more intelligent and competent populations competed against the less-evolved and tended to replace them, thus leading to a rise in the quality of future generations.

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Book Reviews

Genetics and the Search for Modern Human Origins
John H. Relethford
Wiley-Liss, New York, 2001 ISBN 0-471-38413-5

The author, a population geneticist on the faculty of the State University of New York at Oneonta, has written a well-organized and most readable book which investigates what for well over a century has been one of the most hotly contested subjects in academe.

As is well known, the study of anatomical traits early established the evolution of man from primate origins. By the middle of the twentieth century, what is today known as the Multi-Regional Theory of the origin of living humans was generally accepted. I choose to speak of "living humans" rather than of "modern humans" in this context, since the latter expression is poorly defined and is capable of many differing interpretations. Although the term "modern humans" is widely used by contemporary academic writers, there is a great deal of confusion as to when modern humans first appeared. This is because evolution is essentially a chicken-and-egg process; it is hardly possible to discover an anatomically modern child that was sired by parents who could be defined as non-modern. Even living human populations vary in so many details that it has been pointed out that virtually all the individual anatomical features which, taken as a whole, distinguish Classic Neanderthals can be found amongst one or other of the living varieties of man. Only when aggregated together in a single skeleton do they unequivocally mark that fossil to be Neanderthal.

Implicitly acknowledging this problem, the author does not attempt to determine any set of traits that define either modern humans or Neanderthals but instead explains that the common approach is to take as many traits as possible to minimize statistical error and evolutionary fluctuations and get an estimate of the average degree of dissimilarity between the two arbitrarily chosen groups selected for the study.

The radical essence of the Out of Africa theory, based on genetic and anatomical data of both fossils and living

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populations, argues that the ancestors of all living humans reached "modernity" in Africa, and that small populations moved out of Africa into Eurasia as recently as circa 120,000 years ago. Although there is massive evidence that other hominids were already present in Eurasia at that time, the strict Out of Africa theory maintains that these "modern human" migrants totally replaced their non-modern predecessors in Eurasia instead of mixing their genes with them because of either mutual infertility or a primordial racist refusal on the migrants' part to interbreed with the "inferior" native stocks whom they supplanted. However, a few anatomists have persisted in pointing to the seemingly incontrovertible evidence of regional anatomical continuity from pre-modern into modern populations in certain parts of Eurasia, claiming that the human populations currently living outside Africa must have inherited at least some of their genes from earlier pre-modern populations of that area, if indeed they had not evolved quite independently from earlier non-African populations. The evidence advanced to support this view of Multi-Regional Evolution is strongest amongst the Mongoloids of Eastern Asia.

During the last century, debate also centered on the theory that the Classic Neanderthals who occupied Western Eurasia down to around 40,000 years ago had evolved into modern Europeans or, more likely, had at least contributed some genes to the incoming, fully modern Cro-Magnon populations that supplanted them. Both views have now been rejected because of convincing DNA evidence acquired from Neanderthal fossils. This actually has less similarity to the DNA of modern European populations than with hat of contemporary East Asian, African and Australoid populations, although Neanderthal DNA is essentially dissimilar from that of all living humans.

Similarly mitochrondrial DNA recovered from the remains of European Neanderthals does not show any reasonable degree of similarity to the mtDNA of contemporary modern Europeans, which is not surprising in light of the vast anatomical differences which separate them from the Cro-Magnon ancestors of living European Caucasoids. But something more remarkable has come to light regarding the mtDNA of Australoids and the mtDNA extracted from a 60,000-year-old fossil found at Lake Mungo. While the Lake Mungo fossil is anatomically more or less identical to living Australoids, its mtDNA does not match

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that of living Australoids. This suggests that any particular mtDNA evolved can become extinct in the course of evolution, which rather throws into doubt the value of mtDNA evidence in tracing lengthy lineages.

Relethford does not hesitate to state his own opinion as to the validity of the Out of Africa theory, taken in its widest sense, as distinct from the narrower version which would date the migration of already "modern" hominids from Africa to around 120,000 years ago. Although he agrees that the genetic evidence supports the idea that hominids must have originated in Africa, and migrated from thence to Eurasia, he believes that earlier migrations would have occurred and that older pre-modern populations inhabiting non-African territories may have contributed genetically to the evolution of certain of the non-African populations of the contemporary world.

Instead, he quite reasonably assumes that outward migrations from Africa may have involved hominids at various levels of evolution over a lengthy period of time. For example, on the basis of genetic evidence, fossil remains found in Western Eurasia imply that Neanderthals separated from the lineage of "modern humans" probably as long as 700,000 years ago. He therefore expresses the opinion that while several waves of reasonably advanced hominids did migrate from Africa into Eurasia, at various intervals, there is also some validity in the Multi-Regional theory and that subsequent evolution led to the regional disparities in modern populations outside Africa. Indeed, although Relethford does not mention this point, many anatomical anthropologists have argued that truly modern Cro-Magnons and their relatives achieved their "modernity" in Western Eurasia and have argued that those who moved from Africa into Eurasia were only "modern" in the sense of having attained *Homo sapiens* rather than *Homo sapiens sapiens* status.

Ultimately, it would seem, we are faced with a problem of semantics. As long as we regard all living peoples as being equally "modern," and speak loosely of "modern man" having evolved in Africa as though no subsequent evolution of any significance occurred in the very different and challenging environment of Eurasia, the debate will surely continue. Even outside Africa we must ask whether the 60,000-year-old Australoid fossils of Mungo, which anatomically match living Australoids, as "modern" as the 40,000 year old Cro-Magnon

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fossils of Europe, which are ancestral to the contemporary Caucasoids? Over the 40,000/60,000 years that both populations have been in existence there is virtually no comparison to be made between the intellectual creativity and the cultural and technological achievements of the two groups. Is every living human equally "modern" from the evolutionary point of view?

But Relethford is also interesting when he makes comparisons between the genetics of contemporary humans and that of Neanderthals and apes. He provides summaries of this data, as for example when he cites a set of comparisons made by Matthias Krings and colleagues of sequence differences in mtDNA between these three categories of primates. These data revealed differences of approximately 10 percent between living human populations, 35 percent between living humans and Neanderthals, and 95 percent between living humans and apes.

Relethford assumes that from the emergence of Homo erectus onward, hominids had achieved the ability to spread over a wide range of different environments, and that in consequence there would always have been a substantial gene flow between such advanced hominid groups. He supposes that any migrant group would tend to reabsorb genes from the parent group, thereby reducing speciation (we use the term here in the broader sense that would include the formation of subspecies). He is correct in stating that if this in fact occurred it would act as a brake on hominid genetic diversification. However, although we know that such intergroup gene flow is taking place at a fairly rapid rate amongst contemporary human populations, we would hesitate to assume that it would have occurred automatically in much earlier, more primitive hominid societies. As one author said somewhat facetiously, cannibalism tended to restrict gene flow, whereas when improvements in the art of cultivating made slavery useful it increased the gene flow from subordinate to dominant groups.

Many advanced species of birds and mammals living in feral conditions, that have achieved a degree of speciation but have not yet lost the ability to crossbreed, maintain adegree of genetic isolation by avoiding sexual contact whenever perceived physical or behavioral markers prompt psychological rejection. This prevents evolutionary experiments from being brought to an untimely end as a result of genetic reabsorbtion, and further evolutionary diversification into whole separate species could

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never have occurred amongst highly mobile animals. The same reluctance to cross-breed might well have been true of evolving human populations still living under essentially feral conditions..

Relethford also assumes that a continuing gene flow out of Africa tended to work against speciation amongst the human populations that were evolving separately in Eurasia. This is certainly true of the past thousand years or more, when slavery brought a more or less continuous if sporadic flow of slaves from Africa into Asia, and later into the New World. Although the Arabs who brought so many sub-Saharan Africans into the Middle East frequently neutered the male slaves, they produced many hybrid offspring by the female slaves. But is Relethford justified in assuming a continuing gene flow from Africa into Eurasia prior to the invention of slavery? The evidence indicates that over the past hundred thousand years at least, technological advance was more rapid in Europe and Western Asia than in Africa (and we may regard North Africa and Egypt as an extension of the Eurasian continent and of the culture of Western Eurasia). In consequence, from that time on, few migrant groups would be likely to have successfully migrated from a culturally less-advanced Africa into a technologically more-advanced Eurasia, until such historical times as modern Africans were brought into Eurasia by slavery.

One interesting subject seldom touched upon by proponents of the Out of Africa theory is the problem of the origin of the Asiatic Negritoes, who anatomically resemble the sub-Saharan African Negroes quite closely. Evidence of an earlier Negrito population can be found in parts of southern Arabia and southern Iran, in the forests of India, in the Andaman Isles and in the forests if Malaya. They also seem to have contributed genes to the population of parts of Southeast Asia, notably Cambodia. It would seem likely that these are the descendants of an early Out of Africa migration of a Negroid people which, remaining in generally tropical climates, did not experience the novel selective forces that helped shape the ancestors of today's Caucasoids and Mongoloids living in more stringent northern climes. However, the mechanics of such a migration are rather difficult to envisage, since the African Negroes were historically a sub-Saharan population, so far as can be determined, and the area of northeastern Africa, adjacent to

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Asia, has a different terrain and climate, and was not in prehistoric times inhabited by true Negroes. Thus it would have been a very remarkable occurrence if Negroes had migrated into Asia to become the ancestors of the Negrito peoples. Most migrants from Africa presumably moved into Asia from northeastern Africa where they were more likely to have already evolved differently from the proto-Negroids of sub-Saharan Africa, and may have been more closely related to the Khoisan who later inhabited this area.

Clearly, if we are ever to put together the jigsaw puzzle of living man's evolutionary history with some degree of finality, it is urgent that extensive genetic surveys be conducted not on the more homogenized populations of modern cities and advanced societies, but on the few small remnants of ancient populations that still survive relatively unmixed from past ages. The genetics of these rapidly-disappearing populations are of major importance to any hope we may have of success in the search for the evolutionary history of our modern living populations, and we probably have only a few decades left before such remnants become absorbed into the genetic cauldron of Twenty-First-Century humanity.

J. W. Jamieson

Cosmic Legacy:
Space, Time, and the Human Mind
Greg F. Reinking
Vantage Press, New York, 2003 ISBN 0-533-14027-7

In this truly remarkable book, synthesizing contemporary information on space, matter, time and the human mind, the author documents in highly comprehensible language what is known and what can be theorized about the origins and nature of the Universe, Time and Mankind. Human neurological development and theories of consciousness, intelligence and human behavior are discussed against a backdrop of the vast powers at work in the Universe, the age of which was estimated as recently as February 2003 at 13.7 billion years, with a one percent margin of error, on the basis of the cosmic microwave background radiation. .

The Mankind Quarterly

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The author, Greg Reinking, is well equipped to enlighten us on these great mysteries. His academic career began in the field of electrical engineering, following which he conducted research in molecular physics at the Oak Ridge National Laboratory, and then studied medical physics at UC Berkeley. After training in surgery and radiology, he completed Harvard University fellowships with the Diagnostic Neuroradiology and Interventional Neuroradiology groups at Massachusetts General Hospital, and has authored numerous articles in scholarly journals in the areas of physics and medicine.

Pointing out that all terrestrial life is derived from star dust collected from the cosmos billions of years ago, the author is able to relate biogenesis, cognition and intelligent reasoning to final realities such as the nature of matter, time and space. Current theories, he states, assume that at the beginning of the Universe there was some kind of "linkage among matter, energy, space, and time, suggesting these ordinarily discrete properties may have been combined in a single form. In fact, the distortions of matter, space and time were so extreme that time may have lost its identity – blurring the meaning of a beginning." While this Big Bang is believed to mark the beginning of time, we cannot comprehend the meaning of the concept 'the beginning of time.' There is no definitive understanding as to what 'time' really is. "In fact, the moment the Universe began is considered indefinable by some investigators, as they argue that time itself may not have existed in the conventional sense."

> [F]urthermore, the surprising complexity of the vacuum of space, once considered empty and dull, may in fact hold the key to unifying these properties. This vacuum, which surrounds us, permeates us, and occupies the vast majority of the Universe, is the realm of quantum particles and their forces – it acts as a medium that transmits the forces of gravity and electromagnetism. Hidden within this vacuum may be the infinitesimal remains of multiple dimensions of space, curled upon themselves since the genesis of our Universe. These infinitesimal dimensions may define the laws of nature, which govern everything that exists.

Several writers have chosen to illustrate the short history of Mankind in relation to the history of the Earth by analogy to

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events in a 24 hour day, and Reinking has chosen to use this same analogy to portray the history of the Universe within a single year. Since he has applied the latest research to this presentation, it will help the reader to envisage the scope of this work if we quote an abbreviated version here:

Big Bang	January 1
Our galaxy begins forming	late January
Our Sun ignites	mid-September
The solid Earth forms	late September
First living cells	October 7
First animal life	December 7
Primates	December 29, PM
Modern man arrives	December 31, 11:56:30 P.M.
Roman Empire begins	December 31,11:59:54.7 P.M.
First Moon landing	December 31,11:59:59.9 P.M.

Many may regard this as primarily illustrating the brevity of the existence of what contemporary writers choose to call "modern" man (a very vague and arbitrary term), but this reviewer is more impressed by the length of time that life has existed in relation to the total age of the Universe. Indeed, life evolved rapidly on this Earth, once temperature and related conditions permitted, because, as Reinking observes:

> Organic life requires only a few elements, which are relatively abundant in the Universe, but they must be organized in highly complex and consequently unstable compounds, and the conditions on the Earth which gave rise to the coordinated collective biochemical processes which we call life were very different from those of today. The Earth was then relatively cool and enveloped by a thick, damp atmosphere composed of hydrogen, methane, ammonia and water vapor, with very little atmospheric oxygen, this having been put into the atmosphere subsequently by plant life-forms. The primeval atmosphere also lacked ozone, so that the Earth was bathed in ultraviolet radiation, which may have contributed to the formation of the earliest biomolecules.

Although the combination of conditions which permitted life to come into existence were the result of a chance "throw of

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the dice" the emergence of life was virtually inevitable when the dice were thrown multitudinous times. Indeed, the idea that there may be a "great order in the Universe," the product of some intelligent architect, is discarded by the author, who sees only a grand chaos.

Evolution took place along the lines that are now widely appreciated, but the evolution of the range of living humans occurred amongst small groups of hominids widely dispersed under different selective conditions. Sentience, the quality of conscious awareness and interaction derived from processing information received from the senses, seems to many to be the greatest wonder, and the greatest mystery of the Universe. As Reinking states: "The rise of humans from sentience to cognitive intelligence is perhaps the greatest achievement of terrestrial evolution." Living organisms exhibit a continuous chain of increasing complexity and diversity as they evolve from complex and unstable non-living matter to sentient beings, aware of the world around them. Consciousness has perplexed philosophers throughout history, although we now understand that it is a quality which we share, albeit in differing degrees, with other more advanced life forms.

We will not here attempt to summarize all the information that the author provides us about the nature of matter, living organisms, sentience, senescence, sexual dimorphism amongst humans, but the reader may well wish to linger over his comments on that most important quality of mankind: the ability to analyze the data provided by our senses and conceive appropriate reactions to the challenges presented to us by changes in our environment. This involves both memory and the power to reason.

At this point, Reinking's observations on the Universe and evolution begin to be supplemented by neurological explanations, and the emphasis passes somewhat from molecular physics to medical physics. Man learns more quickly and efficiently than other living organisms, and memory is essential to any ability to learn:

> It is generally believed that through learning synaptic connections are reinforced and new ones created. Learning implies a change must be made to store the new information (for later retrieval), which is believed to occur at the level of the

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> synapse. Hebb's rule states that a synaptic connection may be strengthened when the involved neurons are activated at the same time. A form of synaptic plasticity, called long-term potentiation (LTP), occurs in many parts of the brain, including the hippocampus (involved with memory formation).... As enhanced function of synaptic transmission is related to memory formation, the loss of (former) synaptic transmission implies loss of stored information. During the normal aging process of humans, about 25 percent of the synapses deteriorate_between the ages of twenty-five and fifty-five – as does the ability to recall memories. Memory loss begins at about the age of 30 years in normal individuals.

The ability to analyze information presented by the senses and determine appropriate reactions which will promote the survival of the organism involves not only memory but also intelligence. The structure and capabilities of any organism are determined primarily by genetic factors, but although the genes set limits to potential behavior, environmental forces can shape the way in which the potentialities will develop, or even whether they will develop at all. Concerning the heritability of intelligence, a quality of supreme importance to man, Reinking treats this controversial subject with caution, although as we read the entire text of his book we are not left in any doubt as to his objectivity. Intelligence or reasoning power is perhaps not necessarily the exact equivalent of IQ, which is strictly the ability to perform intelligence tests. IQ has been demonstrated without question to be closely related to success in academic pursuits and in life generally, but Reinking protects his academic integrity by avoiding any pedantic statements concerning the heritability of intelligence and confining himself to summarizing the findings of the wide variety of scholars who have debated this subject:

> Studies of twins suggest that about half (30 to 70 percent) of personality traits are a result of hereditary (genetic) factors, leaving the rest to the social environment. It is estimated that only about 5 percent of personality differences are related to being raised by one family versus another (assuming exposure to a relatively "normal" environment with sufficient nurturing and appropriate care). The determinants of the remainder of personality, approximately 50 percent, are unclear and may include brain development prior to birth, exposure to a variety

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of experiences, and social interactions throughout life.

Reinking does, however, mention Arthur Jensen's concerns about the importance of conserving the genetic capacity for intelligent behavior:

> Arthur Jensen, professor of educational psychology at the University of California, Berkeley, proposed that in a complicated technological society (i.e., where intelligence is at a premium for societal stability and function) the population must be able to assimilate an adequate knowledge base. He contends that innate human intelligence has limitations imposed upon it and that the ability to improve intellectual prowess will require eugenic manipulations to enhance intellectual capabilities to cope with the advanced societies of the future.

But he follows this with what reads as a rather tongue in the cheek qualifier: "However, one can argue that since the society in which man lives is fundamentally his own construct, its properties are ultimately derived from human intellect." I take the liberty of describing this as a "tongue in the cheek" remark because it is perhaps painfully obvious that a society with low intelligence might survive (as long as conditions remain favorable) and live quite happily with a low level of culture but, as Arthur Jensen more than once remarked, it would be a great tragedy if all the wonderful heritage of classical music, composed by highly intelligent persons during the past three centuries, were to be lost due to the absence of a sufficiently large proportion of intelligent people capable of appreciating it. Societies with a low level of intelligence can be quite happy with a correspondingly low level of culture, but as sensitive humans we can hardly be blamed for hoping that high cultural achievements will not be lost due to a decline in the intelligence of future generations. Perhaps the only comfort that caring individuals may find in the prospect of a reversal of the historic trend towards higher intellectual capacity is the reflection, brought powerfully home to us towards the end of Reinking's book, that so far as we can anticipate there is no long term future for life in a Universe that may well be moving inevitably toward total self-destruction.

But to return to the theme of Reinking's book, memory, learning and reason are not the only important factors that have

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played a role in the rise of humanity. The ability to direct behavior towards preconceived, long-term goals, rather than simply react blindly to every casual stimulus, is essential to scientific achievement and, indeed, to the very maintenance of a civilized society. On this, Reinking observes that:

> The next level of function, behavior, is what determines how individuals will interact with the environment of which they are aware. Behavior (formulating and implementing intended activities) largely stems from frontal lobe processing. In fact, patients who have suffered frontal lobe injuries may remain completely conscious but lose their ability to initiate tasks or make decisions.

The popular distinction between "low-brow" and "high-brow" seemingly has some physiological justification. Skeletal evidence reveals the persistent increase in the height of the forehead as hominids evolved from their simian forebears, and it is a well-established fact that the skeleton becomes modified to suit the needs of the more active parts of the living organism – in this case, that part of the brain which coordinates action.

Will humanity continue to evolve with the same rapidity that it has done over the past million years? Reinking thinks not, because as the increasingly large human population becomes homogenized into a single genetic mass future evolution will necessarily be slowed – unless further speciation is created artificially by conscious genetic manipulation. Advances in medical science offer the possibility of guided human evolution, otherwise known as eugenics, should the political will to accept such a path be present. Certainly susceptibility to genetic disease could be sharply reduced.

Eugenic medical intervention is a very real possibility, which will not attract the same fierce resistance that proponents of selective breeding have encountered:

> The promise of gene therapy includes eradication of inheritable diseases, some types of cancer, and other genetic disorders. There is great potential for modification of the human genome to improve the genetic constitution, such as creating a more effective immune system with better resistance to disease and diminished predisposition to developing genetically related ailments.

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To the extent that it becomes possible to manipulate DNA, so will mankind acquire the power to direct its own evolutionary course:

> Perhaps, through genetic manipulations in the future, it will be possible to alter the DNA of a child early enough so that the desired characteristic may be expressed independent of the parental genetic contribution. If the change were truly an alteration to the DNA (and included in the chromosomes of the offspring's germ cells), a transmittable genetic trait would be artificially created. This concept may be expanded to allow creation of new traits (new genes). Under such a scenario, the course of genetic change in the human evolutionary path would be a form of unnatural selection.

But there are many threats to further human progress, not least of which is man's own destruction of the very environment on which he depends for survival. Reinking expresses more concern about matters such as overpopulation and pollution, than the debate over intelligence, and he joins his voice to that of the environmentalists in warning his readers about the ongoing ecological havoc being wrought by the careless application of modern technology and the sheer impact of the exploding mass of humanity that now occupies the Earth, and whose numbers are increasing every day. Although we hear much about industrial pollution, and this is very real, overpopulation is an increasingly powerful contributor to pollution, and particularly to the destruction of tropical habitats and the elimination of other forms of higher life which formerly occupied the Earth in plentiful numbers.

> The production of waste is fundamental to all living organisms and is one of the major factors that limit the size of a growing population. Likewise, pollution is an inevitable by-product of human society and comes in several forms: organic, inorganic, and nuclear. In ancient times, waste was generally biodegradable; when left exposed to the elements it would eventually decompose completely – ancient people quickly recognized the benefits of removing and burying waste... Our rapidly expanding world population with its increasing production of waste will undoubtedly produce greater strain on resources and techniques of disposal... A recent example is Nakuru, a Kenyan town known for its beautiful lake supporting

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> millions of flamingos and other wildlife. As the town industrialized, its population grew from 30,000 to 360,000 in forty years, with parallel growth in its production of waste. Despite numerous safeguards, toxic materials are now found in the lake, and the once-abundant wildlife has nearly vanished...
>
> Unless solutions are found, it is unreasonable to expect the present technologically advanced civilizations to continue on the same course and achieve long-term stability as insatiable exploitation plunders irreplaceable natural resources, the human population expands beyond control, the biosphere becomes increasingly polluted, and the resolution of ideological conflicts promotes development of more efficient means of extermination... the resources of the entire Earth seem vast, but they are not infinite and therefore cannot indefinitely support growing civilizations. Eventually a balance must be achieved between the consumption and replenishment of natural resources – the price of failure is too high.

Hopeful signs exist in the West that technology can reverse environmental destruction *provided that the political will is there.* But when we see the massed populations of China and India rapidly adopting modern technology we must question whether their desire to live a comfortable life comparable to that enjoyed by their contemporaries in the Western world will not stop them, with their huge numbers, from wreaking even greater ecological destruction than the much less populous West could possibly achieve.

To what extent can human exploration of the Universe possibly provide an escape for perhaps just a small human pioneer population in the event that life on Earth should become unlivable? Can the boundaries of our environment be extended to include areas outside the confines of our planet? In general, as we all know, the Universe is extremely inhospitable to life. Even our protective cocoon, the Earth's atmosphere, is constantly threatened. Several hundred tons of interplanetary material ranging from dust to small pebbles, is swept into it daily as Earth travels around the Sun. Most of this debris is incinerated before it reaches the surface of the globe. However, on rare occasions, much larger debris, such as asteroids measuring up to several kilometers may be encountered:

> July 1994 was an exciting month for astronomers, a time when

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> attention was focused on the planet Jupiter. Orbiting Jupiter was a recently discovered comet, found to be on a collision course with the planet. The Shoemaker-Levy 9 comet, originally a little smaller than Halley's comet, was pulled apart into a long chain of many smaller fragments by the tug of Jupiter's gravity. Over several days, the impact plumes of the twenty discernible fragments of the comet were carefully followed as they marched one-by-one at sixty kilometers per second and plunged to their explosive finales in the clouds of Jupiter (Figure 15.2). As the individual fragments plummeted into the Jovian atmosphere, they exploded with multimegaton releases of energy, producing Earth-sized defects in the upper cloud decks and spewing 50,000° C ejecta hundreds of kilometers into space... if a cometary impact event of similar proportions took place on Earth, it would be terminal.

Reinking describes various proposals that have been put forward to facilitate the survival of small refugee or pioneer human populations in the extra-terrestrial environment in the event that for one reason or another life became unsupportable on Earth. One proposal, made by a Harvard professor in 1974, suggested that human populations could survive in huge rotating space stations orbiting the Sun. These would rotate in order to simulate gravity, with their interiors designed to provide an approximation of the Earth's living conditions. More recently, Reinking notes:

> ...the feasibility of human occupation of the moon has been raised with the recent evidence of water at the polar regions, as suggested by the Lunar Prospector spacecraft's neutron spectrometer. There may be up to 11 million tons of water beneath the lunar soil in an area up to 50,000 square kilometers – enough water to support a population of 2,000 for more than a century. This figure could be significantly extended with recycling. The lunar water could be used for drinking, as a source of oxygen for air mixtures, and as a source of hydrogen for fuel...

Reinking also mentions that the planet Mars has recently been the subject of speculation as a possible object for human colonization. But while there is a very real possibility of human settlement on the moon, and Mars has an atmosphere, a valuable quality which the moon lacks, the imponderables are as

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yet too great to estimate, and Mars would indeed be a very cold place for humans!

Whatever fanciful concepts such as these may be examined in the hope that technology will one day make them possible, if only for very small communities, the hard fact remains that mankind faces a multitude of perils, and on a less exciting level than extra-terrestrial disaster, we must remember that there are still today several tens of thousands of nuclear weapons stored on the surface of the Earth, and that there are quite a lot of people who would like nothing better than to get their hands on some of these and use them for their own ends.

As for the chance that mankind could at some time in the future successfully explore the boundaries of the Universe, we are warned that "the evidence suggests our Universe lies within its Schwarzschild radius – we are essentially inside a vast black hole, precluding any opportunity to explore what lies outside." Indeed, our present knowledge implies the ultimate disappearance of all life forms anywhere they might exist in the Universe. It is estimated that in about one trillion years the stars will burn out, collapsing into either white dwarf stars or black holes. Black holes will become more common than they now are, until they are swept into larger galactic core black holes, while the Universe continues to expand. Energy may again be released as the black holes themselves eventually disintegrate, "creating a fireworks finale lasting billions of years, marked by occasional flashes scattered throughout a vast abyss. As the Universe expands further, its temperature will continually fall as it approaches absolute zero, leaving the Universe infinitely large, completely dark, and absolutely cold."

That remains a purely speculative forecast, of course, but it is a prophecy based on the best evidence currently available to us.

All philosophers who pontificate on the nature, character and future of mankind and human society should familiarize themselves with the latest findings of science. For the intelligent reader, Reinking's *Cosmic Legacy* is a concise but graphic 390 page introduction, with a useful glossary for the layman, to the very latest that science can tell us about space and man's infinitesimally small place in the Universe and Time – whatever the Universe and Time might be.

J. W. Jamieson

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Our Posthuman Future:
Consequences of the Biotechnology Revolution
Francis Fukuyama
Farrar, Straus and Giroux, New York, 2002, 256 pages, $25.

Redesigning Humans:
Our Inevitable Genetic Future
Gregory Stock
Houghton Mifflin, New York, 2002, 277 pages, $24.

Readers have a right to know a book reviewer's philosophical position, so let me be frank from the outset. I have just finished a manuscript calling for a rebirth of the eugenics movement.

By contrast, Fukuyama in *Our Posthuman Future* makes his own case for an outright ban on reproductive cloning and argues that genetic enhancement should not be used to make children healthier or more intelligent: "The idea that states should legitimately worry about collective goods like the health of their national gene pools is no longer taken seriously but rather associated with outdated racist and elitist attitudes," he writes. For him contemporary biotechnology poses a "significant threat," and he wants to put the entire field under international political control. That means "liberal democracy [which] has emerged as the only viable and legitimate political system." He ignores the fact that most people in the world do not live under such a system.

It should be noted right off that Fukuyama's title was selected for its cachet, and not for its relevance to the content of the book. Evidently the editors felt that a title like "Modern Demographic Trends," which would be far more appropriate, was not likely to catch the collective cyclopic eye of the reading audience.

Contrary to the accepted truism that the time of da Vincis and Lomonosovs has passed and that we should all stick to our respective intellectual cubbyholes, there is a true need for an overview of our place in the universe, and Fukuyama displays an admirable eclecticism. He is actually a professor of political economics, and thus – as is true for the majority of thinkers groping for a handle on humanity's genetic future – his training is distant from genetics and demography. Things have to be that

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way for the time being since demographers have been frightened off by political correctness and know better than to engage in anything more daring than quantitative headcounts, while geneticists are keenly aware that society sees them as mechanics whose job is fix the carburetor and not to advise the driver whether he should make a trip to the opera or the grocery store. Fukuyama picks up a lot of threads, sometimes too many, it must be admitted, but he does attempt to sew from them a shirt. When he is not being distracted by marginal topics, he does indeed approach the right topics in dealing with "one of the most momentous periods of technological advance in history." (Both he and Stock like the phrase "cusp of technology" in this context.)

Fukuyama briefly discusses some of the core sources of resistance to scientific thinking: feminism, religion, and "progressive" as represented by writers like Stephen Jay Gould, whose 1981 *Mismeasure of Man* was a blatant hatchet job on studies of biological causality, and Leon Kamin, who has argued that "there exist no data which whould lead a prudent man to accept the hypotheses that IQ test scores are in any degree heritable." Fukuyama also points out that the charges of data fabrication leveled against Cyril Burt were themselves fabricated.

On occasion Fukuyama is more than a little off base. For example, he maintains that "the advantages of higher intelligence are relative and not absolute." While the "relative" advantage of intelligent individuals over others is indeed a given, it is incomprehensible that anyone could argue that intelligence is not an absolute advantage in and of itself. Another example of flowed understanding: Fukuyama claims that "intelligence is not the work of a single g factor but is rather a series of closely related abilities." This is precisely the definition of g given by Arthur Jensen. Or Fukuyama maintains that eugenics was suppressed as a result of revelations of abuses by Nazi eugenicists. In point of fact, the eugenics movement was not suppressed until 1968, when the Holocaust memorial movement was launched and eugenics was proclaimed to be the ideology of Holocaust, despite the fact that American and British eugenicists vigorously denounced Hitler's racism and anti-Semitism on the eve of World War II. Still another instance of dubious statements is the claim that "preferences in music are almost entirely shaped by environment." If we accept this logic,

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we have to believe that, given the right family environment, Bach would have been a devotee of rap music. Still another statement by Fukuyama about which I confess to having mixed feeling is: "The species-specific differences between nonhuman animals on the one hand and human beings on the other make a tremendous amount of difference to our understanding of their moral status." Fukuyama warns of the danger of an emerging "genetic overclass." He is wrong: this is not a danger, but a current reality that no one wishes to admit. Fukuyama also promotes the popular misconception that "the Left has historically sought to play down the importance of heredity in favor of social factors." In point of fact, many of the founding fathers of the eugenics movement were socialists.

Fukuyama distinguishes between "human rights" and "human needs and interests," the latter being dismissively referred to as having been determined on a strictly utilitarian basis. This is a fundamentally specious distinction, and one that takes on heavy emotional overtones in addition when Fukuyama begins comparing utilitarian ethics with cannibalism. Basically, when the persons whose interests or desires are being thwarted are present and able to protest, the topic is one of "rights," whereas when the interests of the yet unborn are trampled, the topic is defined as "needs and interests." Fukuyama's attitude toward ethical reciprocity and human rights as based on human nature, which involves species-level altruism, is on the whole quite positive, although his embrace of the position is not without reservations.

Fukuyama searches for a middle road between genetic interventionist and *laissez faire* policies, admitting that John Locke's *tabula rasa* theory now lies in shambles. But while he opposes state eugenics, he is much more favorably inclined to eugenic measures taken by individuals. On a philosophical level he appears to resist pure scientific reasoning. Humanity for him is constituted by a nebulous, undefined "Factor X" which the electronic brain will never achieve. Consciousness, he would have the reader believe, gives the lie to "reductionism materialist science": "We want to protect the full range of our complex, evolved natures against attempts at self-modification. We do not want to disrupt either the unity or the continuity of human nature, and thereby the human rights that are based on it." He then goes on to the topic of abortion, where he "admits to

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considerable confusion." As for his proposed global ban on reproductive cloning, he argues that the procedure is "unnatural" and creates "a very asymmetrical relationship" between clone and donor, mistakenly – in my view – referring to the donor as "parent."

Ultimately, Fukuyama is indeed confused. He first claims to oppose human genetic engineering, but then wavers.

The book contains neither a subject nor a names index. There are footnotes and a bibliography, but on occasion Fukuyama leaves out data sources which he should have included, as, for example, when he cites heritability estimates of homosexuality as ranging between 31 to 74 percent for men and 27 to 76 percent for women.

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Gregory Stock in his *Redesigning Humans: Our Inevitable Genetic Future* strongly advocates voluntary eugenics practiced on an individual level, although he abjures the word "eugenics." Instead, he employs the latest code phrases – "germinal choice technology" (GCT) and "enhancement" – and describes such procedures as "freeing" us from state sponsored "coercive" eugenics.

Stock goes through the expected list of genetic interventions in the germ line, including embryo screening, advanced *in vitro* fertilization, embryo implantations, and the replacement or modification of individual genes and/or clusters of genes. For him "the question is no longer whether we will manipulate embryos, but when, where, and how."

Stock is entirely correct in pointing out that parents, presented with the opportunity to improve their children's health and intelligence, will not pass up the opportunity. As proof he cites a 1993 international poll in which 22% of Israelis, 43% of Americans, 63% of Indians, and 83% of Thais said they would do so if given the opportunity.

There is a sarcastic Russian expression to the effect that it is possible to extract teeth, not through the mouth, but by beginning at the other end of the intestinal tract (forgive my euphemistic phraseology), but "Why bother?" Stock's advocacy of such genetic interventions as jettisoning or adding auxiliary chromosome pairs which would serve as "scaffolding" for new genes, natural and artificial, on occasion brings that phrase to mind:

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> Imagine that a future father gives his baby daughter chromosome 47, version 2.0, a top-of-the-line model with a dozen therapeutic gene modules. By the time she grows up and has a child of her own, she finds 2.0 downright primitive. Her three-gene anticancer module pales beside the eight-gene cluster of the new version 5.9, which better regulates gene expression, targets additional cancers, and has fewer side effects. The anti-obesity module is pretty much the same in both versions, but 5.9 features a whopping nineteen antivirus modules instead of the four she has and an anti-aging module that can maintain juvenile hormone levels for an extra decade and retain immune function longer too. The daughter may be too sensible to opt for some of the more experimental modules for her son, but she cannot imagine giving him her antique chromosome and forcing him to take the drugs she uses to compensate for its shortcomings. As far as reverting to the pre-therapy, natural state of 23 chromosome pairs, well, only Luddites would do that to their kids.

In all fairness to Stock, the above is written somewhat tongue-in-cheek, but still the basic question remains: Why bother? Certainly germline enhancement is coming down the pike, and in as much as this is a book written precisely on that topic, Stock is right in discussing the various technologies which may be possible in the future, but his rejection of traditional positive and negative eugenic methodology, which have proven their efficacy in other species, appears to be inspired chiefly by fear of the environmentalist-egalitarian thought police, Stock's representations to the contrary notwithstanding. He even goes so far as to defend the right of deaf parents to test early-stage fetuses and abort those who are not deaf: "No one could argue that they were injuring a healthy child." So why not blindness? Or any number of genetic illnesses?

Like Fukuyama, Stock is correct in pointing out that selective genetic "enhancement" could lead to a still greater breakdown into genetic classes than we already have. Or, with state-sponsored health insurance, tighten up the distribution curves, creating for a society of greater, not lesser equality. (Stock seems a little confused here, speaking instead of a "flattening of the distribution of individual endowments.")

And he is unquestionably right concerning the inevitability of GCT:

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> We add or remove hair, straighten our teeth, fix our noses, enhance or reduce our breasts, get rid of fat. We use drugs to reduce pain, lose weight, change moods, stay awake. The idea that we will long forgo better and more powerful ways of modifying ourselves is a denial of what the past tells us about who we are.

Furthermore, once any major state (China comes first to mind) introduces such a policy, other countries will be left with the choice of doing the same or becoming the vassals of the children of the state.

Like Fukuyama, Stock discusses highly targeted pharmaceuticals working in parallel with genetic enhancement. And like Fukuyama, he does get sucked into what might be called the "kitchen sink" fallacy, trying to pick up too many threads at once.

Lastly, the discussion of animal breeding is entirely correct. We have bred animals for special abilities, not for overall general ability. There is a distinct danger of a misguided society pursuing precisely that route with regard to humankind.

Like Fukuyama's, Stock's footnote system is frustratingly incomplete. Rather than providing specific sources to facts cited, he provides general notes by page order.

*

In summation both books are testimony as to the resurfacing of eugenics under the cover of voluntarism and individual freedom of choice. Both are basically popularizations and do not break new intellectual ground, but they are nevertheless serious, multi-disciplinary works, and they can be recommended for the lay audience.

John Glad

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